

NUCLEAR SCIENCE ABSTRACTS

Vol. 7, No. 20, October 31, 1953

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CALENDAR OF MEETINGS

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March 15-19, 1954

ELEVATED TEMPERATURE CORROSION SYMPOSIUM, Municipal Auditorium, Kansas City, Mo. Sponsored by: National Association of Corrosion Engineers - 10th Annual Conference

Person to Contact: Glenn A. Fitzlen
Ass't. Technical Director
Haynes Stellite Co.
Kokomo, Ind.

June 20-25, 1954

NUCLEAR ENERGY CONFERENCE, University of Michigan, Ann Arbor, Michigan, Sponsored by: American Institute of Chemical Engineers.

Inquiries should be addressed to: Professor Donald Katz, University of Michigan, Department of Engineers, Ann Arbor, Michigan.

ERRATUM

NSA, Vol. 7, No. 15. In abstract 4477, p. 542, in title, 15 Mev should be 14 Mev.

REPORTS REFERENCE LIST

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The abstract number for each report is listed at the upper right of the entry. If the number bears an asterisk, the report is title listed only and no abstract is included.

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Los Alamos Scientific Lab.
AN EXPERIMENTAL METHOD TO DETERMINE EQUATION OF STATE DATA FOR SOLIDS BY SHOCK WAVE MEASUREMENTS. Russell H. Christian and John M. Walsh. [nd] Decl. July 15, 1953. 18p. (AECD-3540; LADC-1421)
- AECD-3542 5518
Radiation Lab., Univ. of Calif., Berkeley
THE FURNACE SPECTRUM OF PLUTONIUM. John G. Conway. May 12, 1953. Decl. July 16, 1953. 30p. (AECD-3542; UCRL-2213)
- AECD-3543 5650
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THE HALF LIFE OF Am^{243} . Herbert Diamond, Paul R. Fields, Joseph Mech, Mark G. Inghram, and David C. Hess. June 1953. Decl. with deletions July 17, 1953. 4p. (AECD-3543; ANL-WMM-1109)

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THE USE OF I^{131} IN IMMUNOLOGIC INVESTIGATION. Frank J. Dixon. [1953] 11p. (AECU-2604)
- AECU-2605 5458
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LACTOSE SYNTHESIS IN MAMMARY GLAND PREPARATIONS. G. W. Kittinger and F. J. Reithel. [1953] 19p. (AECU-2605)
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SUPERCONDUCTIVITY OF TECHNETIUM. John G. Daunt, Ohio State Univ. and J. W. Cobble, Oak Ridge National Lab. [1953] 5p. (AECU-2612)
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A NOTE ON THE ALLOXAN DISTRIBUTION IN THE RAT. Bernard R. Landau and Albert E. Renold. [1953] 9p. (AECU-2618)
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MAXIMUM LIFETIME OF INTERMEDIATES IN THE HILL REACTION; STUDIES OF PHOTOSYNTHETIC PROCESSES. Hugh S. A. Gilmour, Rufus Lumry, and John D. Spikes. May 1, 1953. 12p. (AECU-2619; Technical Report 9)

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- AECU-2623 5467
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- AECU-2624 5468
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THE FLAME PHOTOMETRIC DETERMINATION OF PHOSPHATE. William A. Dippel, Clark E. Bricker, and N. Howell Furman. [1950] 15p. (AECU-2631)
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- ISC-278 5512
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RAPID ESTIMATES OF LIMITS FOR NET TRANSPORTS
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Robert W. Deutsch. July 1, 1953. 76p. (UCRL-2258)
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THE HYDROLYTIC POLYMERIZATION OF ZIRCONIUM
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- UCRL-2269 5581
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A SIMPLE ANALOGUE INSTRUMENT FOR SUMMING
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A METAL VACUUM LOCK FOR A MASS SPECTROMETER.
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- AERE-C/R-1133 5583
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THE CALORIMETRIC ESTIMATION OF ALPHA EMITTERS.
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- DRCL-110 5528
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APPLICATION OF DIFFUSION THEORY TO DISPERSION
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- NBS-2552 5571
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CHARACTERISTICS OF TWO TYPES OF TEMPERATURE
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(NP-4713)
- NP-4714 5519
Centre de Physique Nucléaire de L'Université Libre de
Bruxelles
ANALYSE SPECTROGRAPHIQUE DU THORIUM ET
PREPARATION D'OXYDE DE THORIUM NUCLEAIREMENT
PUR. [SPECTROGRAPHIC ANALYSIS OF THORIUM AND
PREPARATION OF NUCLEARLY PURE THORIUM OXIDE.]
R. Cypres. June 1953. 21p. (NP-4714; Bull. Note 40)

- NP-4718 5546
Battelle Memorial Inst.
PRODUCTION OF SOUND DUCTILE JOINTS IN MOLYBDENUM; PROGRESS REPORT. M. I. Jacobson, D. C. Martin, and C. B. Voldrich. July 17, 1953. 26p. (NP-4718)
- NP-4722 5559
Bell Telephone Labs., Inc.
LOW-DRAIN AUDIO OSCILLATOR; FINAL REPORT ON TASK 1. D. E. Thomas, L. B. Valdes, W. J. Pietenpol, R. M. Ryder, and C. Flannagan. June 1, 1952. 44p. (NP-4722)
- NP-4723 5525
Massachusetts Inst. of Tech.
BOILING HEAT TRANSFER PROJECT. MONTHLY PROGRESS REPORT. George Henry, Milton W. Raymond, Joseph B. Walsh, and Peter Griffith. Jan. 1, 1953. 6p. (NP-4723)
- NP-4724 5510
De Paul Univ.
THE BIPYRAMIDAL XY_2Z_2 MOLECULAR MODEL. PART 1. CLASSICAL VIBRATION PROBLEM. Joseph S. Ziomek. Submitted Aug. 12, 1953. 27p. (NP-4724; Technical Report 1)
- NP-4727 5547
Case Inst. of Tech.
VARIATION OF THE ADIABATIC ELASTIC CONSTANTS OF ALUMINUM WITH TEMPERATURE. T. R. Long and Charles S. Smith. July 1953. 22p. (NP-4727; Technical Report 12)
- NP-4775 5520
Department of Mines and Technical Surveys, Mines Branch, Ottawa (Canada)
THE DETERMINATION OF URANIUM IN CONCENTRATES BY THE FLUOROPHOTOMETRIC METHOD. J. B. Zimmerman, F. T. Rabbitta, and E. D. Kornelsen. July 13, 1953. 11p. (NP-4775; TR-112/53)
- NP-4776 5521
Department of Mines and Technical Surveys, Mines Branch, Ottawa (Canada)
THE DETERMINATION OF URANIUM BY REDUCTION WITH STANNOUS CHLORIDE. A. R. Main. June 15, 1953. 16p. (NP-4776; TR-111/53)
- TEI-326 5543
Geological Survey
AN IMPROVED TUBULAR ELECTRIC FURNACE FOR THE CLOSED-TUBE DISTILLATION OF OIL FROM OIL SHALE. Frank Cuttitta and Charles A. Kinser. May 1953. 15p. (TEI-326)
- TEI-334 5544
Geological Survey
IDENTIFICATION AND OCCURRENCE OF URANIUM AND VANADIUM MINERALS FROM THE COLORADO PLATEAUS. A. D. Weeks and M. E. Thompson. Apr. 1953. 69p. (TEI-334)
- USNRDL-400 5474
Naval Radiological Defense Lab.
THE EFFECT OF X IRRADIATION UPON THE PERFORMANCE OF VOLITIONAL ACTIVITY BY THE ADULT MALE RAT. D. C. Jones, D. J. Kimeldorf, D. O. Rubadeau, G. K. Osborn, and T. J. Castanera. Apr. 17, 1953. 22p. (USNRDL-400)

GENERAL

ATOMIC POWER

5456

ZIRCONIUM AND NUCLEAR REACTORS. Edward C. Miller. In "Zirconium and Zirconium Alloys." Cleveland, American Society for Metals, 1953. (p.327-40)

The longer-range problems incidental to the large-scale development of atomic power from nuclear fission are discussed, particularly as the problems place nuclear, chemical, and mechanical requirements upon potential reactor structural materials such as Zr. Some of the fields of activity in the Zr program being carried on by Oak Ridge National Lab. are briefly reviewed. (auth)

RESEARCH PROGRAMS

5457

UTILIZATION OF RADIATION FROM FISSION PRODUCTS. G. N. Walton and J. Wright. *Nature* 172, 147-9(1953) July 25.

Papers read at a symposium on the use of fission product radiation held by the Chemistry Division of the Atomic Energy Research Establishment, Harwell, during February 23-24, 1953, are reviewed. Object of the symposium was to decide what steps should be taken by the Directorate of Atomic Energy and by potential users if fission product radiation is to be used fully in the national interest. (E.S.)

BIOLOGY AND MEDICINE

5458

Oregon Univ.

LACTOSE SYNTHESIS IN MAMMARY GLAND PREPARATIONS. G. W. Kittinger and F. J. Reithel. [1953] 19p. (AECU-2605)

A soluble protein which will catalyze the synthesis of lactose from glucose-1-phosphate and starch has been obtained from a lactating guinea pig mammary gland. Starch- C^{14} , when incubated with mammary gland homogenates, was converted in part to lactose- C^{14} in the absence of added adenosine triphosphate. The glycolytic behavior of mammary homogenates and of a protein preparation derived therefrom was studied. Rates of lactose synthesis in homogenates, glycogen levels and glycogen synthesis in mammary homogenates, and amounts of lactose synthesized in mammary protein are tabulated. (J.A.G.)

5459

Institute for the Study of Rate Processes, Univ. of Utah
MAXIMUM LIFETIME OF INTERMEDIATES IN THE HILL REACTION; STUDIES OF PHOTOSYNTHETIC PROCESSES. Hugh S. A. Gilmour, Rufus Lumry, and John D. Spikes. May 1, 1953. 12p. (AECU-2619; Technical Report 9)

Preoxidized chloroplast fragments mixed with a solution of K ferricyanide were illuminated in an attempt to demon-

strate the existence of reduced intermediates in the Hill reaction. The apparatus and methods used are described. Results indicate the existence of unstable chemically active photoproducts which decay in less than 1 sec. Possible mechanisms of the reaction are discussed. (C.H.)

5460

Los Alamos Scientific Lab.

RELATIONSHIP OF PYRIDOXINE AND ITS DERIVATIVES TO THE MECHANISM OF ACTION OF ISONIAZID. Irene U. Boone and Kent T. Woodward. [1952] 18p. (AECU-2626; LADC-1477)

Lactobacillus plantarum and *Saccharomyces carlsbergensis* were inhibited in a synthetic medium by isoniazid concentrations of less than 10^{-2} M. This inhibition was competitively reversed by pyridoxine, pyridoxamine, and pyridoxal. In reversing isoniazid inhibition of *Lactobacillus* pyridoxamine and pyridoxal were from 1000 to 4000 times as effective as pyridoxine. Two strains of *E. coli* were inhibited with isoniazid with partial reversal with pyridoxine and derivatives. Larger amounts of the metabolite were required and the reversal was not as typically competitive. No reversal of isoniazid inhibition could be obtained with vitamin B₆ or its derivatives in any of the *Mycobacteria* tested. It seems more likely that if isoniazid acts as an antagonist of pyridoxine or its derivatives, it is not a simple substrate competition or uptake phenomenon. (auth)

5461

Cancer Research Inst., New England Deaconess Hospital, Boston

SUBSTRATE UTILIZATION BY EHRlich's MOUSE ASCITES CARCINOMA CELLS. Ralph W. McKee and Karl Lonberg-Holm. Cancer Research Inst., New England Deaconess Hospital, Boston and Harvard Medical School. [1952] 16p. (AECU-2629)

A washed tumor cell system which could be employed for chemical and biological studies was obtained from Ehrlich's mouse ascites carcinoma cells, a variant of the Ehrlich breast carcinoma. The oxidative metabolism of this system was not appreciably influenced by wide changes in total ionic strength or by variation in ionic pattern. The metabolism is adversely affected by a lowering of the pH below 7.4, and irreversible enzyme damage is apparent above pH 7.4. The quantity of cells in the system can be determined by direct count, packed-cell volume measurement, or dry-weight determination, the latter 2 being the best criteria for quantitation. This washed tumor cell system had a lowered concentration of exogenous substrates and after 1 hr of respiration showed a lowered O consumption. This "endogenous" respiration could be markedly stimulated by adding glutamate, lactate, pyruvate, oxalacetate, malate, succinate, α -ketoglutarate, citrate, aspartate, and alanine. The addition of small amounts of glucose to the cell system stimulated oxidation whereas large quantities inhibited oxidation. Glucose is utilized at a rate of about 0.96 mg/hr/0.4 ml (17×10^6) tumor cells. Lactate is utilized at a rate of about 0.13 to 0.27 mg/hr/0.04 ml cells, the higher rate with glucose as the substrate. (auth)

5462

Tennessee Univ.

AGRICULTURAL RESEARCH PROGRAM QUARTERLY

RESEARCH PROGRESS REPORT FOR THE TWO QUARTERS
ENDING MARCH 31, 1953 AND JUNE 30, 1953. [July 20,
1953] 131p. (ORO-98)

The tissue distribution, excretion, and placental transfer of Y^{91} were studied after intravenous administration to cattle and intramuscular administration to rats. The "isotope-dilution" and "comparative-balance" methods for the determination of endogenous fecal Ca in cattle are compared. Irradiation of burros caused a decrease in body H_2O , but the significance of this is not fully determined. It was observed that a corn-cob meal ration red to chicks inhibited growth and caused the endocrine glands to remain infantile in size. The thyroid function in rats after total-body irradiation was studied by I^{131} tracer techniques. A case history is reported of an osteogenic sarcoma in a muskrat which fed on plants containing large amounts of radioactive Sr. The effects of total-body irradiation of burros on respiration and blood values are reported. (For preceding period see ORO-90.) (L.M.T.)

5463

Radiation Lab., Univ. of Calif., Berkeley
GROWTH-STIMULATING EFFECTS BY NUCLEOPROTEIN
AND CELL FRACTIONS ON CHICK HEART FIBROBLASTS
IN VITRO (thesis). Roman Joseph Kutsky. July 1953. 51p.
(UCRL-2270)

Data are presented on the growth-stimulating effects of various nucleoproteins and cell fractions from chick embryo extract on in vitro cultures of chick heart fibroblasts. Fractionation, isolation, and analytical methods used in preparation and identification of the fractions are included. A method is outlined for preparing nucleoprotein fractions for use in tissue cultures, in which the use of streptomycin allows the omission of sterile precautions. (C.H.)

5464

Radiation Lab., Univ. of Calif., Berkeley
LIPOPROTEIN METABOLISM AND LIVER DAMAGE
(thesis). Frank T. Pierce, Jr. July 22, 1953. 83p.
(UCRL-2276)

The effects of impaired liver function on the levels of lipoprotein in the blood were studied. Injections of carbon tetrachloride were used to impair liver function in rabbits, and the serum cholesterol levels and serum lipoproteins of various densities were determined during and after injections. Data are tabulated. The serum levels of lipoproteins of various densities were measured in 32 patients with chronic hepatitis, and a correlation is suggested between acute hepatitis, density of serum lipoproteins, icterus index, serum bilirubin levels, and results of thymol turbidity tests. In normal rabbits injected with lipoproteins isolated from cholesterol-fed rabbits, lipoproteins of high densities were converted to lipoproteins of lower densities in a progressive manner. (C.H.)

5465

Atomic Energy Project, Univ. of Rochester
THE RELATIONSHIP OF THE CELL SURFACE TO
METABOLISM. 10. THE LOCATION AND FUNCTION OF
INVERTASE IN THE YEAST CELL. D. J. Demis, A.
Rothstein, and R. C. Meier. June 9, 1953. 16p. (UR-263)

The invertase activity of the living yeast cell is 300 times the fermentative capacity. The uranyl ion reversibly inhibits the invertase activity of living yeast cells by a non-competitive mechanism probably involving a combination of the ion with carboxyl groups. Invertase activity is only 1/10th as sensitive to U as the fermentation of glucose. The addition of orthophosphate to the medium reverses the U inhibition in both cases, even though the concentration required is only 1/100th the concentration of intracellular orthophosphate. From distribution studies it was found that sucrose and the hydrolysis products, glucose and fructose,

are located almost exclusively in the extracellular water. No invertase was secreted into the medium. It is concluded that invertase is located on the surface of the cell and that it functions as a digestive enzyme. Hydrolysis by surface invertase accounts for essentially all of the sucrose utilization by the cell. (auth)

RADIATION EFFECTS

5466

Utah State Agricultural Coll.
THE USE OF RADIOISOTOPES IN THE STUDY OF RE-
PRODUCTION. FINAL REPORT, PART 1. Clyde Biddulph.
July 1, 1953. 26p. (AECU-2611)

Female rats injected with P^{32} were bred to normal males, and injected males were bred to normal females. P^{32} decreased the frequency with which the injected males copulated, but the mating response in the injected female was not affected. The injection of P^{32} had no effect on the length of gestation, the birth weight or growth rate of offspring, or the sex ratio. The number of offspring and of embryos that implanted in the uterus was reduced by the injection of P^{32} . The offspring of injected animals did not mate or reproduce normally. The estrous cycle of the female rat injected with P^{32} became irregular, and this irregularity persisted for a period of 5 to 30 days after the injection. The primordial follicles of the female rat were not affected by P^{32} . Endocrine-gland weights of normal, gonadectomized, and P^{32} -injected male and female rats were compared. The seminal vesicles and prostate of the injected animal were heavier than those of the normal animal. The weight of the thyroid gland decreased following castration, but the pituitary gland increased. In the female rat the ovaries and adrenals decreased in size following injection. The thyroid and pituitary glands were unaffected. (J.S.R.)

5467

Marquette Univ. School of Medicine
THE EFFECTS OF LARGE DOSES OF PARATHYROID
EXTRACT, VITAMIN D, AND DIHYDROTACHYSTEROL ON
MICE AND RATS FOLLOWING ADMINISTRATION OF
RADIOACTIVE CALCIUM AND STRONTIUM. W. A. D.
Anderson and Gloria E. Zander. 29p. (AECU-2623)

Certain aspects of pathologic mineral deposit in bones and soft tissues were studied with Ca^{45} . Parathyroid extract, dihydrotachysterol, and large doses of vitamin D were given to radioactive mice and rats in an attempt to cause mobilization of radioactive and stable Ca from bones and soft tissues. The tissues were examined, and findings indicated no pathological effect on the soft tissue of mice or rats when vitamin D and parathyroid extract were administered; however, thickening of the end of the femur was noted in all cases in rats. Dihydrotachysterol produced calcification in both soft tissue (lungs, heart, kidney, etc.) and bone tissue. (J.A.G.)

5468

Marquette Univ. School of Medicine
THE PATHOLOGIC EFFECTS OF RADIOACTIVE CALCIUM
AND STRONTIUM OR THE BONES OF CF_1 MICE. W. A. D.
Anderson and Gloria E. Zander. [nd] 11p. (AECU-2624)

Ca^{45} , injected intraperitoneally as single doses of 3.5 or 5 μ C/g, or weekly doses of 0.6 or 2.1 μ C administered for about a year, resulted in the production of bone tumors in mice. Smaller doses produced no tumors. Bone tumors were also obtained in mice which received weekly doses of 1.5 or 2.1 μ C Sr^{90} for about six months. Autoradiographs demonstrated less radioactivity in the tumor tissue than in the intact bone. (C.H.)

5469

Northwestern Univ. Medical School
INTRA-PROSTATIC INJECTIONS OF RADIOACTIVE

COLLOIDS. 2. DISTRIBUTION WITHIN THE PROSTATE AND TISSUE CHANGES FOLLOWING INJECTION IN THE DOG. George J. Bulkeley, John A. Cooper, and Vincent J. O'Connor. [1952] 10p. (AECU-2628)

Distribution and excretion of radioactive colloidal chromic phosphate (P^{32}) and gold (Au^{198}) following injection into the prostate gland in dogs were studied. Additional studies were made on the early and late tissue changes within the prostatic capsule. Injection of the 2 radioactive substances produced no appreciable effect in organs distant from the prostate except in the case of the regional lymphatics following the injection of radiogold. Distribution of the colloidal material throughout the prostate was not uniform in any instance, and in none of these animals was destruction of the normal prostate complete. Periprostatic reaction was marked in the case of both materials, but more prominent following the injection of radioactive gold. When healing had occurred, large numbers of normal prostatic glands remained, and, in some cases, normal glands persisted within the center of the healed radiation scar. This was true following injection of both radioactive gold and radioactive chromic phosphate. The acute radiation reaction to P^{32} in the dog's prostate differs from the reaction to Au^{198} , but the long term result is about the same following injection of either material. (J.A.G.)

5470

Brookhaven National Lab.
CALCULATION OF I^{131} BETA RADIATION DOSE TO THE BONE MARROW. James S. Robertson and John T. Godwin. [nd] 7p. (BNL-1528)

The area occupied by bony trabeculae in representative fields of the bone marrow from human ribs and vertebrae was found to average 12% of the total area. The fraction of the I^{131} β -particle energy absorbed by bony trabeculae in the bone marrow is estimated as 20% of the energy released in the marrow. If the concentration of I^{131} in bone marrow equals that in the blood, the β -radiation dose delivered to the marrow is about 20% less than the dose delivered to the blood. (auth)

5471

Radiological Research Lab., Columbia Univ.
ANNUAL REPORT ON RESEARCH PROJECT. G. Failla and H. H. Rossi. June 1, 1953. 89p. (NYO-4523)

Physics. Design is reported of plastic tissue-equivalent ionization chambers for the measurement of both fast and slow neutrons. Design of a proportional counter is reported, with tissue-equivalent walls and gas at low pressure, for determination of the dose delivered as a function of the specific ionization of the particles crossing the counter. Data are presented on response of the counter to α particles. Satisfactory thin water films for α -particle stopping-power determinations have been made. Progress is reported on the development of methods for counting β particles. Modifications of a method for the determination of surface and depth doses of β applicators have resulted in increased speed and accuracy of the measurements, and counting results on Sr^{90} and Y^{90} sources are presented. An ionization chamber is described for the determination of the dose in ergs/g from radioactive material in a single cell. A method for the preparation of large-plane radioactive standards with a known and uniform concentration of radioactive material for use in the calibration of survey instruments is described in detail. Radiobiology. A marked anemia was observed in mice and rabbits within a few days following exposure of the exteriorized spleens of the animals to x irradiation. Changes in ultraviolet sensitivity and photoreactivity of T1 bacteriophage under different conditions of irradiation are reported, and conclusions derived from the results are discussed. Cytological and histological

observations on hamster tissues following exposure to varying dosages of x radiation are reported. An immediate and drastic depletion of hepatic glycogen following irradiation was demonstrated in mice, hamsters, and salamanders. A decreased fertility was demonstrated in mice irradiated in utero. Histological observations on the grounds of these mice are described. A slight protective effect was demonstrated for thiouracil against I^{131} -produced damage to the thyroid gland. The effects of chronic small doses of I^{131} on the thyroid glands and gonads of mice are described. The protective effects of cysteinamine against radiation injury was demonstrated in the germ cells of the clam *Spisula*. Data are included on effects of radiation on sperm and eggs of the clam and effects of radiation on connective tissue. X irradiation increased absorption of subcutaneously injected solutions of nembutal in mice. The results of a study of the effects of x radiation, deuterons, α particles, and β particles on the rabbit lens are presented, and the effect of radiation on metabolism in the lens is discussed. A list of articles published and accepted for publication during the period is included. (For preceding period see NYO-4008.) (C.H.)

5472

Atomic Energy Project, Univ. of Calif., Los Angeles
EFFECT OF MID-LETHAL WHOLE BODY X-RAY EXPOSURE OF MICE ON THE PRODUCTION OF ACUTE PULMONARY EDEMA BY AIR BLAST INJURY. B. Cassen and K. Kistler. Issued Aug. 19, 1953. 10p. (UCLA-266)

In acute pulmonary edema, produced in mice and rats by blast injury or massive epinephrine administration, the edema fluid had a total solids content similar to that of blood plasma, in contrast to the usual findings of low total solids in edematous effusions. A natural assumption would be that in acute pulmonary edema there are large holes produced in the capillary walls through which plasma may exude. As there is evidence in severe radiation damage that the capillaries are weakened in some manner, enabling some extravasation of blood elements, experiments were performed to measure the degree of acute pulmonary edema produced by blast injury on radiation-weakened animals. They showed a considerably higher degree of edema production than the non-irradiated controls. (auth)

5473

Atomic Energy Project, Univ. of Rochester
THE APPLICATION OF INFRARED SPECTROPHOTOMETRY TO THE DETECTION OF POSSIBLE PROTEOSES AND PEPTONES IN THE BLOOD OF IRRADIATED ANIMALS. David S. Smith. May 18, 1953. 61p. (UR-251)

A blood plasma fraction was obtained which comprised those substances which are dialyzable and precipitated by alcohol. The material, dried on a AgCl plate, was examined by infrared spectrophotometry in the range 2 to 12 μ . Rabbits were given 2000-r whole-body x irradiation, and blood samples taken at times from 4 hr to 5 days afterward, or at death, were examined. There was no evidence of the presence of proteoses or peptones, and no indication that the amino acid content was greatly altered. The limit of detection of proteoses by this method is about 20 mg %. (auth)

5474

Naval Radiological Defense Lab.
THE EFFECT OF X IRRADIATION UPON THE PERFORMANCE OF VOLITIONAL ACTIVITY BY THE ADULT MALE RAT. D. C. Jones, D. J. Kimeldorf, D. O. Rubadeau, G. K. Osborn, and T. J. Castanera. Apr. 17, 1953. 22p. (USNRDL-400)

Standard volitional activity wheels were used to determine the effects of single acute doses of x rays upon adult male Sprague-Dawley rats in a study of physical performance and malaise. Under controlled conditions of light, temperature, and sound level, the daily activity of each animal

was recorded for consecutive periods as long as 11 weeks after x-ray doses of 200, 300, 400, 540, 680, 800, 900, or 1,000 r. At all doses studied there was an abrupt significant depression of activity. This initial decrease in activity was immediately followed by a period of recovery (increasing activity). At 200 and 300 r recovery was complete within 5 days of irradiation, and there was no further discernible effect of irradiation at this level upon volitional activity. At doses of 400 r or greater there was a second significant decrease in activity, which reached a minimum value during the third week after irradiation. The time necessary for survivors to complete recovery from this second decrease in activity appeared to be proportional to the x-ray dose. When animals died within the first 9 days after irradiation, their activity decreased continuously from the time of irradiation until death. With decedents which survived longer than 9 days, the initial decrease in activity was followed by some recovery and then by a second decrease in activity which continued until death. (auth)

5475

EFFECT OF ULTRA-VIOLET, X-RAYS, AND NUCLEAR RADIATIONS ON RING-ROT BACTERIA INFESTING BURLAP POTATO BAGS. G. H. Starr and C. A. Cinnamon. *Phytopathology* 43, 439-40(1953) Aug.

Ultraviolet rays, x-ray and nuclear radiations were used experimentally to kill ring-rot bacteria (*Corynebacterium sepedonicum*) infesting burlap potato bags. Exposures of ultraviolet rays up to 60 min, high voltage x rays up to 15 min, low voltage x rays up to 10 min, and nuclear radiations of 22 hr or more, were not effective in killing ring-rot bacteria; neither did they indicate practical value in ring-rot control. On the materials used, however, the radioactive iron gave some evidence of partial control and possibly should be tested further. (auth)

5476

FURTHER STUDIES ON THE EFFECTS OF CARBON DIOXIDE AND OXYGEN ON THE FREQUENCY OF X-RAY INDUCED CHROMOSOME ABERRATIONS IN TRADES-CANTIA. Howard A. Schneiderman and Edward D. King. *Proc. Natl. Acad. Sci. U.S.* 39, 834-8(1953) Aug.

Exposure to CO₂ during irradiation markedly increases the radiosensitivity of cells. The concentration of O₂ present has a profound effect on the radiosensitivity. The interaction of these two gases is examined, and a mode of action of CO₂ in increasing radiosensitivity is defined. (auth)

5477

RADIOACTIVE EFFECTS ON THE B.O.D. OF SEWAGE. Werner N. Grune. *Sewage and Ind. Wastes* 25, 882-97 (1953) Aug.

The effects of various concentrations of P³² and of I¹³¹ on both the first and second stages of biochemical oxidation of sewage were studied. A flow diagram illustrating the experimental procedure is included, and results are summarized. (C.H.)

5478

A NEW TECHNIQUE FOR THE STUDY OF THE EFFECTS OF X-RADIATION ON MAMMALIAN SKIN MAINTAINED AT DIFFERENT TEMPERATURES DURING EXPOSURE. J. P. O'Brien, J. A. Belli, D. E. Wood, and J. W. Saunders, Jr. *Science* 118, 135-6(1953) July 31.

A technique is described for simultaneously regulating the temperature of mammalian skin and shielding adjacent tissues during studies of the effects of radiation on the skin. (C.H.)

5479

THE FITTING OF MULTI-HIT SURVIVAL CURVES. A. W. Kimball. *Biometrics* 9, 201-11(1953) June.

The fitting of theoretical survival curves to data obtained from radiation experiments with microorganisms is dis-

cussed from a statistical point of view. Formulas are given for obtaining estimates of parameters and standard errors. The methods are illustrated with two sets of experimental data. (auth)

5480

EFFECT OF 400 FRACTIONAL WHOLE BODY γ -IRRADIATION IN THE BURRO (*EQUUS ASINUS ASINUS*). Bernard F. Trum, Thomas J. Haley, Murray Bassin, John Heglin, and John H. Rust. *Am. J. Physiol.* 174, 57-60(1953) July.

A study has been made of the response of the burro to fractional Co⁶⁰ γ -ray whole-body irradiation. This animal's response is similar to that observed in other animal species after irradiation. A pronounced hyperferremia was observed in the burro one hr after completion of the first 400-r exposure and this condition increased up to the 6th irradiation day. Plasma-Fe values were significantly elevated in most animals prior to exitus. (auth)

5481

STUDIES ON THE DOSIMETRY AND BACTERICIDAL EFFECTS OF GAMMA RADIATIONS FROM A COBALT⁶⁰ SOURCE. Samuel A. Goldblith, Bernard E. Proctor, Sol Davison, David A. Lang, Billy Kan, Charles J. Bates, and Marcus Karel. *Radiology* 60, 732-5(1953) May.

The dosimetry of a kilocurie source of Co⁶⁰ is described. The relative radiosensitivities of 11 bacterial species to the γ rays of Co⁶⁰ are presented. Relative sterility dose requirements found both experimentally and by calculation are tabulated. (auth)

RADIATION HAZARDS AND PROTECTION

5482

CONTAMINATION AND DECONTAMINATION OF LABORATORY BENCH-TOP MATERIALS. W. Lane, R. Fuller, L. Graham, and J. Mackin. *Nucleonics* 11, No. 8, 49(1953) Aug.

Contamination and decontamination experiments were conducted on phenolic and polyester resins, commonly used as bench-top covering materials. P³², Y⁹¹, and Sr⁹⁰ were used as contaminants. Decontamination steps are given using alkyl aryl sulfonate, (ethylenediamine)tetraacetic acid (tetrasodium salt), and 6M HNO₃. (K.S.)

5483

HAZARD EVALUATION AND CONTROL AFTER A SPILL OF 40 Mg OF RADIUM. R. K. Skow, V. V. Vandivert, and F. R. Holden. *Nucleonics* 11, No. 8, 45-7(1953) Aug.

A contamination survey is made of laboratory personnel and equipment on the occasion of a 40-mg spill of Ra. Decontamination procedures are outlined. (K.S.)

5484

PROTECTION AGAINST RADIATION LETHALITY: EFFECT OF β -MERCAPTOETHYLAMINE. R. Rugh and S. C. Wang. *Proc. Soc. Exptl. Biol. Med.* 83, 411-14(1953) June.

Some 32% of the Swiss albino and 67% of the CF₁ male mice injected intraperitoneally with β -mercaptoethylamine (i.e., cysteinamine) prior to a lethal exposure of 700 r whole-body x irradiation survived the 30-day observation period. Some 97% of these are still alive 60 days after irradiation. The CF₁ mice, exposed to the higher dose of 800 r after injection, showed 58% survival while the controls, receiving only 700 r, all died within 20 days. Thus prior injection of this compound definitely affords radiation protection to mice. Injection after x irradiation, whether single or multiple, had an adverse effect on survival. (auth)

5485

RESULTS OF THE DETERMINATION OF INDIVIDUAL EXPOSURE IN X-RAY AND Ra WORKERS AND COMPARISON OF EXPOSURES TO CLINICAL FINDINGS. Jan Müller, Marie Houšková, and Svatopluk Pražák. *Pracovní Lékařství* 5, No. 3, 121-7(1953). (In Czechoslovakian)

A simple method for the routine determination of the individual exposures to x rays and γ rays is given. The daily exposure of 97 workers was determined. For the average worker the daily dose was 0.02 r; for nurses, and others working in close contact, the daily dose was 0.1144 r. The opinion is given that whole-body exposures of 0.3 r per week may cause radiation damage. (J.S.R.)

RADIATION SICKNESS

5498

SHOCK, TOXEMIA IN RADIATION LETHALITY. Roberts Rugh, Josephine Suess, and John Scudder. *Nucleonics* **11**, No. 8, 52-4 (1953) Aug.

The lethality of x rays on male albino mice injected with polyvinyl pyrrolidone (PVP) is investigated. Over-all results indicate that PVP, whether in combination with Macrose or Dextrose, does not have any protective value for mice if administered either before or after exposure to 700-r x rays. (K.S.)

RADIOTHERAPY

5487

Brookhaven National Lab.

NEUTRON CAPTURE THERAPY WITH BORON IN THE TREATMENT OF GLIOBLASTOMA MULTIFORME. Lee E. Farr, William H. Sweet, James S. Robertson, Charles G. Foster, Herbert B. Locksley, D. Lawrence Sutherland, Mortimer L. Mendelsohn, and E. E. Stickley. [1953] 32p. (BNL-1521)

The feasibility is shown of the use of a nuclear reactor to provide a neutron source for B^{10} capture therapy of glioblastoma multiforme. A series of 10 patients were treated, of whom 5 received a single irradiation, one received 2 irradiations, 2 each received 3 irradiations, and 2 each received 4 irradiations. Multiple irradiations were in general given at 5- to 6-week intervals. Temporary amelioration of clinical symptomatology suggesting retardation of tumor growth followed 8 of 21 capture therapy efforts, questionable improvement followed 6 of the remaining 13 efforts, and no detectable change followed 7 of the treatments. Only one of 5 patients receiving multiple treatments registered no improvement at any time. Periods of observation of up to 6 months, during which patients received up to 4 capture therapy procedures, revealed no serious complications of this therapy. (auth)

TRACER APPLICATIONS

5488

Pittsburgh Univ. School of Medicine

THE USE OF I^{131} IN IMMUNOLOGIC INVESTIGATION. Frank J. Dixon. [1953] 11p. (AECU-2604)

In a neutral or alkaline solution proteins are readily iodinated. The I^{131} remains attached to the protein until the latter is degraded beyond recognition. The labeled protein can be followed with Geiger tubes, but precautions should be taken to ensure that the I^{131} measured really represents the originally labeled compound. Radioautographic examinations can be made as a check of the counter accuracy. Typical experiments in which labeled proteins are valuable are given. 24 references. (J.S.R.)

5489

Harvard Medical School

A NOTE ON THE ALLOXAN DISTRIBUTION IN THE RAT. Bernard R. Landau and Albert E. Renold. [1953] 9p. (AECU-2618)

The distribution of injected radioactive alloxan in rat tissues was determined radioautographically. The concentration of radioactivity in the islets and connective tissue of the pancreas was higher than in the surrounding acinar

tissue, but was not higher than in kidney, liver, lung, or spleen. The fact that high radioactivity was found within minutes after injection in the renal tubules accounted for the large portion of isotope which can be recovered from the kidney as compared to other tissues. (J.A.G.)

5490

Hanford Works

STUDIES OF METABOLIC TURNOVER WITH TRITIUM AS A TRACER. 3. COMPARATIVE STUDIES WITH TRITIUM AND DEUTERIUM. Roy C. Thompson and John E. Ballou. July 2, 1953. 15p. (HW-28595)

Thirty-two rats were administered HTO and D_2O in a constant ratio over a 5-week period. Animals were then sacrificed in groups over a 2-month period and the ratio of bound T to bound D determined in various tissues. Fat, brain and muscle showed a significant preferential incorporation of D. There was no consistent trend of change in ratios for a given tissue over the 60-day period. (auth)

5491

THE USE OF ISOTOPES IN IMMUNOLOGY. G. E. Francis. *Biochem. Soc. Symposia* (Cambridge, Engl.) No. 10, 49-62 (1953).

The use of isotope tracer techniques in immunological investigations in vivo is reviewed, and results in recent studies are summarized. 55 references. (C.H.)

CHEMISTRY

5492

Institute for the Study of Rate Processes, Univ. of Utah
THE MECHANISM OF ELECTRON EXCHANGE REACTIONS IN SOLUTION; STUDIES OF PHOTOSYNTHETIC PROCESSES. Rudolph J. Marcus, Bruno J. Zwolinski, and Henry Eyring. June 1, 1953. 39p. (AECU-2620; Technical Report 10)

In a previous report (AECU-2271) the above authors presented a collection of the available data on the rates of electron-exchange reactions and proposed a theory of electron tunneling as pertinent to the interpretation of their mechanism. An extension and a more quantitative interpretation of the original suggestions are presented here. The theory developed appears to have merit in understanding a class of oxidation-reduction reactions and several related processes which involve electron transfers. The correctness of this model follows from known facts about the electron-exchange reactions, and from theoretical considerations. A method is introduced for finding the most stable activated complex, i.e., of largest (negative) internal energy, by finding the extremal value for the overall rate constant. This maximization of the specific rate constant was necessary to find the best distance of approach for the interacting ions leading to largest values for the probability of electron penetration consistent with the smallest energy of activation. An approximate expression for the closest distance of approach is derived and related to variables such as temperature, dielectric constant, and nature of the reacting ionic species. (auth)

5493

Mallinckrodt Chemical Lab., Harvard Univ.

CYCLOPENTADIENYL COMPOUNDS OF CHROMIUM, MOLYBDENUM AND TUNGSTEN. Geoffrey Wilkinson. June 30, 1953. 6p. (NYO-6131)

Bis-cyclopentadienyl metal compounds can be synthesized by the vapor phase reaction of cyclopentadiene with metal carbonyls at elevated temperatures. Compounds of Cr, Mo, and W have been prepared in this manner. (J.S.R.)

5494

Radiation Lab., Univ. of Calif., Berkeley
THE HYDROLYTIC POLYMERIZATION OF ZIRCONIUM
(thesis). Albin John Zielen. July 1953. 84p. (UCRL-2268)

The hydrolysis of Zr(IV) perchlorate was investigated by means of an organic complexing agent, thenoyltrifluoroacetone, over a range of Zr concentrations extending from $10^{-5}M$ to $0.3M$ and in 1 and $2M$ perchloric acid solutions at $25^{\circ}C$. The monomeric Zr species at these acidities is shown to be the simple Zr^{+4} ion. The formation of hydrolysis polymers was found to commence at approximately $10^{-4}M$ Zr in $1M$ acid and at approximately $5 \times 10^{-4}M$ Zr in $2M$ acid. The hydrolysis polymers studied are identified as a trimer and a tetramer and are assigned the formulas $Zr_3(OH)_4^{+8}$ and $Zr_4(OH)_6^{+8}$. Equilibrium constants for the observed polymer formation are listed. The results of other investigations of Zr hydrolysis are discussed and compared with the conclusions of this work. (auth)

5495

Atomic Energy Project, Univ. of Rochester
COLLECTED STUDIES ON HYDROXYL APATITE. William F. Neuman. June 11, 1953. 35p. (UR-238)

In the course of years, a wide variety of experiments have been performed on a single sample of hydroxyl apatite, the prototype mineral of bone crystals. In this report, these scattered data are collected for easy reference. Among the kinds of information described are chemical analyses, x-ray-diffraction patterns, specific surface-area measurements, solubility data, and ionic-exchange results, including the heteroionic substitution of various cations for Ca and the displacement of phosphate by CO_2 . (auth)

5496

THE COMBUSTION OF SPHERICAL PARTICLES IN FLOW. EXPERIMENTS CARRIED OUT AT HIGH TEMPERATURE AND THE DETERMINATION OF THE COEFFICIENTS OF REACTION IN GAS EXCHANGE. G. Uglénoda. Translated from Part III, Chap. VII, p.287-327 [of] COMBUSTION OF CARBON; EXPERIMENTAL INVESTIGATION OF THE PHYSICO-CHEMICAL PRINCIPLES OF THE PROCESS. A. F. Predvoditelev, ed. Moscow, *Izd-vo Akademii Nauk S.S.S.R.*, 1949. 407p. (AEC-tr-1577)

5497

THE CHEMISTRY OF THORIUM. V. SOME OBSERVATIONS ON THE 8-QUINOLINOL CHELATES OF THORIUM. Therald Moeller and M. Venkata Ramaniah. *J. Am. Chem. Soc.* **75**, 3946-9(1953) Aug. 20.

Thorium forms with 8-quinolinol a yellow chelate of composition $Th(C_9H_6NO)_4$ and an orange compound of composition $Th(C_9H_6NO)_4 \cdot C_9H_6NOH$. The latter compound is obtained reproducibly by precipitation at pH 4.3 and drying at not above $80-85^{\circ}$ and has a lower thermal stability than commonly reported. Absorption spectra and x-ray-diffraction data indicate that although the 1 to 5-compound is a chemical entity, it has a stable existence only in the solid state. It is suggested that the extra mole of 8-quinolinol is held, therefore, by weak lattice forces. The 1 to 4- and 1 to 5-compounds give absorption spectra differing only in absorption intensities in a variety of organic solvents. For all solvents except absolute ethanol, these spectra suggest hydrolytic decompositions to 8-quinolinol. For absolute ethanol, the spectra compared with those of stable inner complex 8-quinolinol chelates but are converted by the addition of water to the spectrum of 8-quinolinol. The 8-quinolinol derivatives of Th are of no use for the spectrophotometric determination of that element. (auth)

AEROSOLS

5498

APPLICATION OF MOLECULAR FILTER MEMBRANES TO

THE ANALYSIS OF AEROSOLS. Alexander Goetz. *Am. J. Public Health* **43**, 150-9(1953) Feb.

A survey is reported of the properties of molecular filter membranes and their application to the assay of atmospheric environment for suspended particulate matter. Data are included on the performance of the filters in aerosol analysis. (C.H.)

5499

AIR SAMPLING WITH MEMBRANE FILTERS. Melvin W. First and Leslie Silverman. *Arch. Ind. Hyg. and Occupational Med.* **7**, 1-11(1953) Jan.

The properties of molecular membrane filters are described, and their use in collection of air samples for microscopic dust analysis, gravimetric dust analysis, aerosol-particle-size determinations, and for the separation of very fine dusts, and the collection of acid mists and metal fumes for analysis are discussed. (C.H.)

5500

RADIOACTIVE AEROSOLS. Čestmír Jech. *Pracovní Lékařství* **5**, No. 3, 147-52(1953). (In Czechoslovakian)

A review is given of radioactive aerosols. Their origin, occurrence, control, and use are discussed. 27 references. (J.S.R.)

ANALYTICAL PROCEDURES

5501

Princeton Univ.
THE FLAME PHOTOMETRIC DETERMINATION OF PHOSPHATE. William A. Dippel, Clark E. Bricker, and N. Howell Furman. [1950] 15p. (AECU-2631)

A possible new method for the quantitative analysis of phosphates is suggested by the very strong inhibition of the Ca flame emission intensity induced by the presence of phosphate. It was shown that the inhibition of the Ca flame intensity increased linearly with phosphate concentration up to $0.012M$ H_3PO_4 if 1000 ppm of Ca were present. Several phosphate rocks were analyzed by comparing the emission intensities of their solutions containing unknown amounts of phosphate with previously prepared standards. This method makes possible the quantitative analysis of anionic substances which produce no emission themselves in the Lundegardh flame. The measurement of flame photometric inhibition for the quantitative estimation of the inhibitor is a procedure which has not been greatly exploited but which shows promise for the estimation of other inhibitors. (auth)

5502

Atomic Energy Research Establishment, Harwell, Berks (England)
A MICRO-PHOTOMETER USING MODULATED LIGHT AND ITS APPLICATION IN AN URANIUM FLUORIMETER. C. D. Florida and C. N. Davey. June 9, 1953. 14p. (AERE-EL/R-1195)

A microphotometer with a sensitivity of about 10^{-10} lumens is described. This instrument has been incorporated in a fluorimeter for the determination of very small quantities of U. This fluorimeter is also described, and test results are quoted which show that an average instrument has a sensitivity permitting about 5×10^{-10} g of U to be measured. (auth)

5503

DETERMINATION OF URANIUM USING A SIMPLE POLAROGRAPHIC SET-UP. Kaljo Käärik. *Radiometer Polarographics* **2**, 105-6(1953) June.

In this method for the determination of U organic matter is destroyed with HNO_3 and $HClO_4$ and U is extracted from a solution containing a large amount of perchlorates. (E.S.)

5504

DETERMINATION OF THE OXIDES OF TANTALUM, NIO-

BIUM, AND TITANIUM IN THEIR MIXTURES BY RADIO-ACTIVITY. J. Beydon and C. Fisher. *Anal. Chim. Acta* **8**, 538-45(1953) June. (In French)

The oxides of Nb, Ta, and Ti can be determined in their mixtures by means of radioactive tracers. Two methods that have been studied are as follows: (1) by irradiation of the mixture with slow neutrons and measurement of the activity of the Ta¹⁸² formed, Ta can be determined within about 10% in mixtures poor in this element. (2) Nb⁹⁵ of known specific activity is added to the solution to be determined, then Ta and part of the Nb are precipitated by tannin at pH 3.8. Nb is then precipitated in the filtrate at a higher pH. The activity measurement of the 2 fractions allows the determination of how the partition is effected, and the introduction of the necessary correction. Ti is determined by colorimetry after calcination of the redissolved oxides. (auth)

5505

URANIUM IN UREA SOLUTIONS: VISCOSITY EFFECTS AND SPLITTING OF THE WAVE. Kaljo Käärrik. *Radiometer Polarographics* **2**, 89-91(1953) Mar.

In connection with a thorough investigation on the polarography of U in acid non-complexing (ClO₄⁻, NO₃⁻, and Cl⁻) and complexing (SO₄²⁻, PO₄³⁻, and C₂O₄²⁻) solutions, the effect of the concentration and the viscosity of the supporting solution was studied with urea as the viscosity-increasing component. (auth)

ATOMIC WEIGHTS AND PERIODIC SYSTEMS

5506

SECONDARY PERIODICITY IN THE ELEMENT TABLE OF D. I. MENDELEEV. V. P. Shishokin. *Zhur. Obschchei Khim.* **23**, 889-93(1953) June. (In Russian)

The relation between the tangents, expressed by Moseley's Law, and the ordinal number of the elements established a periodicity curve with the following periods: H-He, Li-Ne, Na-Ni, Cu-Pd, Ag-Pt. In a vertical direction in Mendeleev's table, the ionization potentials of the elements of the chief subgroups change periodically in relation to the period number. There is a significant periodic change in the atomic weight, atomic volume, and radius of the positive and negative crystalline ions. A periodic change of the heat of formation of chemical compounds is combined with a similar change of the ionization potential. (J.S.R.)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5507

SIMPLE SCINTILLATION CRYSTAL GROWING TECHNIQUE. W. A. Little. *J. Sci. Instr.* **30**, 253(1953). July.

A method for growing naphthalene or anthracene-naphthalene scintillation crystals is described, in which a test tube containing the melt is inserted into a water-filled vacuum flask. Two or three monocrystals 5 to 8 cm long, 0.5 cm wide, and 3 to 8 mm thick were obtained from each 1/2-in. diameter test tube. (E.S.)

LABORATORIES AND EQUIPMENT

5508

Carbide and Carbon Chemicals Co. (Y-12)
A METAL VACUUM LOCK FOR A MASS SPECTROMETER. Chester R. Fultz and Loyd V. Wilson. July 25, 1953. 11p. (Y-990)

The metal vacuum lock was designed for use on the all-metal mass spectrometer for the routine analyses of solid samples. Its function was to reduce the pump-down time following the changing of the solid samples. By use of a removable ionization chamber retort for insertion of samples, 18 to 25 analyses can be made in 24 hr. (J.E.D.)

5509

A SIMPLE AGITATION DEVICE FOR HIGHLY RADIOAC-

TIVE VOLUMETRIC FLASKS. L. E. Preuss. *J. Sci. Instr.* **30**, 252-3(1953). July.

A remotely controlled handling device for volumetric flasks containing solutions having an activity above 25 mc is described. The clamping head with adjustable straps is fixed at the end of a long tube in which the controlling mechanism is located. Agitation and other manipulations may be readily performed. (E.S.)

MOLECULAR STRUCTURE

5510

De Paul Univ.

THE BIPYRAMIDAL XY₃Z₂ MOLECULAR MODEL. PART 1. CLASSICAL VIBRATION PROBLEM. Joseph S. Ziomek. Submitted Aug. 12, 1953. 27p. (NP-4724; Technical Report 1)

Symmetry coordinates are set up from the standpoint of group theory for describing the normal modes of oscillation of the XY₃Z₂ molecular model in such a manner that maximum factorization of the secular determinant is accomplished. The cubic and quartic portions of the anharmonic potential function are derived, and the components of vibrational angular momentum are set down. The complete valence-type potential function is discussed. Explicit relations are derived between the force constants occurring in the secular determinant and the physical valence force constants. (auth)

RADIATION CHEMISTRY

5511

Brookhaven National Lab.

NUCLEAR REACTORS, FISSION PRODUCTS AND THEIR POSSIBILITIES AND LIMITATIONS FOR THE INDUSTRIAL FUTURE OF RADIATION CHEMISTRY. Bernard Manowitz. [July 2, 1953] 15p. (BNL-1519)

Nuclear reactor by-products have radiation characteristics which make them potentially useful for initiating chemical reactions. The design parameters of large-scale γ irradiators are discussed. The potential of radiation power for polymerization reactions is described. The future supply and cost of nuclear-reactor by-product irradiators are such that they probably can be profitably used only for unique applications. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

5512

Ames Lab.

CONDUCTANCES, TRANSFERENCE NUMBERS AND ACTIVITY COEFFICIENTS OF SOME RARE EARTH HALIDES. I. Sanford Yaffe and F. H. Spedding. June 1952. 112p. (ISC-278)

The conductances, transference numbers, and activity coefficients of aqueous solutions of La, Pr, Nd, Gd, and Er bromides and of Gd chloride at 25°C were determined for concentrations up to 0.1N. The accuracy for all determinations was within 0.1%. (auth)

5513

Los Alamos Scientific Lab.

CHELATION OF THE RARE EARTH ELEMENTS AS A FUNCTION OF pH USING THENOYLTRIFLUOROACETONE. Hugh James Bronaugh and John F. Suttle. June 1953. 33p. (LA-1561)

Data presented here deal with the chelation of the rare earth elements by use of thenoyltrifluoroacetone (TTA). Data were obtained for Sc, Y, and all the rare earths except Er. A method is described for the separation of the lighter rare earths from each other by using chelation with TTA. A liquid continuous extraction apparatus has been designed and used to make fractional separations of Ce from La and Y from Ce. (auth)

5514

OBSERVATIONS ON THE RARE EARTHS. LXII. SOME OBSERVATIONS ON SOLUTIONS OF CERTAIN RARE EARTH METAL SALTS IN BASIC SOLVENTS. Therald Moeller and Paul A. Zimmerman. *J. Am. Chem. Soc.* **75**, 3940-3(1953) Aug. 20. (cf. NSA 5-6695)

In investigations preliminary to the study of the electrolysis of rare earth metal salts in anhydrous basic solvents, it was found that certain of these anhydrous salts are moderately soluble in both ethylenediamine and monoethanolamine but only slightly soluble in morpholine. General solubility decreases were found in the order acetates, nitrates, iodides, bromides. Monoethanolamine was found by conductance studies to be superior to ethylenediamine as an ionizing solvent for weak electrolytes, but for stronger electrolytes, particularly in dilute solution, ethylenediamine was found to be superior. Morpholine was shown to be a poor electrolytic solvent for all compounds studied. In general, rare earth metal acetates were found to be weak electrolytes, whereas nitrates, bromides and iodides were fairly strong electrolytes. (auth)

SEPARATION PROCEDURES

5515

Iowa State Univ.

SEPARATION IN THE GASEOUS PHASE BY MEANS OF POROUS MEMBRANES. David William Brubaker and Karl Kammermeyer. March 1953. 142p. (COO-160; Progress Report 6)

Permeability and separation data are presented for H, He, N, O, CO₂, NH₃, SO₂, methane, ethane, ethylene, propane, and butane as gases and as vapors through several porous membranes. The porous membranes included three samples of porous glass and one sample of an experimental ceramic membrane. Data are included on the effects of temperature and pressure on the permeability constants of the gases and vapors through the porous membranes and on the separation of gases and vapors by the membranes. (C.H.)

5516

Columbia Univ.

[COLLOIDAL BEHAVIOR OF PHOSPHATE SLUDGES;] ANNUAL PROGRESS REPORT. Victor K. La Mer. Issued Feb. 28, 1952. 10p. (NYO-3285)

The feasibility of concentrating the solid content of slimes by coagulation and settling after treatment with Ca(OH)₂ or potato starch was investigated. For slimes containing approximately 3% solids, the volume of the settled solid is about $\frac{1}{2}$ to $\frac{1}{6}$ of the total volume of slime, depending on the dilution. The supernatant liquid is clear and may be siphoned off or the solid flocs may then be filtered. The water from the filtrate may be used to dilute slime before coagulation. The optimum conditions for coagulation and settling in individual types of slimes must be determined since the settling and coagulation rates depend upon the solid content of the slimes. (auth)

5517

SEPARATION OF NEPTUNIUM FROM URANIUM AND FISSION PRODUCTS ON AN ION-EXCHANGE RESIN. Georg Johansson. *Svensk Kem. Tidskr.* **65**, No. 5, 79-88 (1953).

Methods are described for the ion exchange separation of Np(IV) in a pure and carrier-free form from U and fission products in a neutron-irradiated U solution. In one method described the ion exchanger was used after the Np was separated from most of the U by a La fluoride precipitation. In the other method the ion exchange separation was made without combining it with precipitation on a carrier. (C.H.)

SPECTROSCOPY

5518

Radiation Lab., Univ. of Calif., Berkeley

THE FURNACE SPECTRUM OF PLUTONIUM. John G. Conway. May 12, 1953. Decl. July 16, 1953. 30p. (AECD-3542; UCRL-2213)

The spectrum of Pu was observed over a temperature range of 2000 to 2600°C and a wavelength coverage of 3476 to 6888 Å. The spectrum was excited in a modified King furnace, and the lines observed are listed. The wavelengths were measured with a Bausch and Lomb spectrum-measuring magnifier and should be accurate to approximately 0.1 Å. The intensities were on a 0 to 10 scale and showed only the relative change with temperature. (J.E.D.)

5519

Centre de Physique Nucléaire de L'Université Libre de Bruxelles

ANALYSE SPECTROGRAPHIQUE DU THORIUM ET PREPARATION D'OXYDE DE THORIUM NUCLEAIREMENT PUR. [SPECTROGRAPHIC ANALYSIS OF THORIUM AND PREPARATION OF NUCLEARLY PURE THORIUM OXIDE.] R. Cypres. June 1953. 21p. (NP-4714; Bull. Note 40)

Results of an experiment are tabulated for the quantitative determination of 20 separate metals in the presence of Th, together with a qualitative determination of Zr and Ta in Th. Spectrographic means were employed. Permissible metallic concentrations for detection are given. The feasibility of the solvent extraction of Th from nitrate solution is discussed. The solvents studied were ethyl ether, methyl isobutyl ketone, mesityl oxide, and amyl, isopropyl, and butyl acetate. Results show that Th could not be extracted from solutions where large concentrations of impurities were present. (K.S.)

URANIUM AND URANIUM COMPOUNDS

5520

Department of Mines and Technical Surveys, Mines Branch, Ottawa (Canada)

THE DETERMINATION OF URANIUM IN CONCENTRATES BY THE FLUOROPHOTOMETRIC METHOD. J. B. Zimmerman, F. T. Rabbitts, and E. D. Kornelsen. July 13, 1953. 11p. (NP-4775; TR-112/53)

The quantitative determination of U in minerals and ores, based on the fluorescence emitted by UO₂F₂ when irradiated with ultraviolet light, has been extended to the analysis of gravity and chemical concentrates for U. Two important modifications to the previous method have been introduced. Firstly, a modified micropipette is used to minimize pipetting errors; and, secondly, a sufficiently large number of determinations is obtained to give a good statistical average. The method is rapid and simple. Interferences are usually negligible, but, if appreciable, can be eliminated by a simple separation. Good precision and accuracy can be attained. (auth)

5521

Department of Mines and Technical Surveys, Mines Branch, Ottawa (Canada)

THE DETERMINATION OF URANIUM BY REDUCTION WITH STANNOUS CHLORIDE. A. R. Main. June 15, 1953. 16p. (NP-4776; TR-111/53)

SnCl₂ quantitatively reduced U from U⁺⁶ to U⁺⁴ in near boiling 6 to 12N acid solution. The reaction was catalyzed by Fe and driven to completion by orthophosphate. The excess SnCl₂ was oxidized in the cold by HgCl₂, and the U and Fe catalyst were titrated with standard dichromate. An Fe and indicator blank was subtracted to obtain the U titer. Orthophosphate, arsenate, bismuthate, sulfate, perchlorate, permanganate, ceric, tungstate, pyridinium, ammonium, and

cobaltous ions were tested and did not interfere. Molybdate, cupric, vanadate, and titanous ions did interfere by giving high results. The method was precise and rapid and gave good results with standard samples. Unknown samples run by SnCl_2 reduction tended to show higher U than by the Jones reductor method. (auth)

ENGINEERING

HEAT TRANSFER AND FLUID FLOW

5522

Brookhaven National Lab.

HEAT TRANSFER RATES FOR CROSS-FLOW OF WATER THROUGH A TUBE BANK AT REYNOLDS NUMBERS UP TO A MILLION. O. E. Dwyer, T. V. Sheehan, R. T. Schomer, Joel Weisman, and F. L. Horn. [1952] 23p. (BNL-1518)

Heat-transfer coefficients have been obtained at high Reynolds numbers for cross flow of high-temperature, high-pressure water through a tube bank consisting of 200 tubes. The tubes were 0.810-in. OD and spaced on an equilateral triangular grid. This study is the first of its kind using water and the first exceeding a Reynolds number of about 50,000 for any fluid. In the range of Reynolds numbers investigated, the coefficients were found to be considerably greater than those predicted by extrapolation of the Colburn equation. For example, at a Reynolds number of 1,000,000 the coefficients are about 60% greater. This increase in the coefficient is due to the fact that it was found to vary approximately as the 0.8 power of the Reynolds number instead of 0.6, as indicated by the Colburn equation. The higher exponent at the higher Reynolds numbers is shown to be consistent with heat-transfer results on single cylinders, with pressure-drop data, and with mass-transfer data, by drawing an analogy between mass and heat transfer. The coefficients increased from the first to the third transverse row of tubes, after which they remained constant. At Reynolds numbers of 10^5 and 10^6 , the coefficients for the tubes in the first transverse row were approximately 30 and 40%, respectively, below the average coefficient for the lattice as a whole. The tubes near the two side walls gave average coefficients which were about 15% higher than those in the interior of the lattice. (auth)

5523

Livermore Research Lab., Calif. Research and Development Co.

TRANSIENT TEMPERATURE AND THERMAL STRESS EQUATIONS FOR A HOMOGENEOUS FLAT PLATE HEATED BY MULTIPLE PULSED CYCLIC HEAT GENERATION. D. F. Casey. Issued Aug. 1953. 22p. (MTA-18)

Equations are presented for the transient temperatures and thermal stresses in a flat plate for any multiple-pulsed, cyclic, square-wave heat-generation input. As an example, transient temperatures and thermal stresses are computed for an assumed flat plate with an assumed heat-generation input pattern. (auth)

5524

Massachusetts Inst. of Tech.

BOILING HEAT TRANSFER PROJECT. PROGRESS REPORT [FOR] MAY 1953. George Henry. June 1, 1953. 10p. (NP-4713)

Photographic data taken for the $\frac{1}{2}$ -in. channel height under the revised degassing technique for pressures of 500 and 1000 psia at velocities of 20 and 30 fps and for the 1500 psia pressure at 20 fps were statistically analyzed for the vapor

volume and mixture-density quantities. The results are reported in the form of mixture-density ratio vs. heat-flux plots for the five pressure-velocity combinations. Graphs showing density ratio vs. heat flux are included. (auth)

5525

Massachusetts Inst. of Tech.

BOILING HEAT TRANSFER PROJECT. MONTHLY PROGRESS REPORT. George Henry, Milton W. Raymond, Joseph B. Walsh, and Peter Griffith. Jan. 1, 1953. 6p. (NP-4723)

Visual density data for 30 fps were recorded for pressures and temperatures up to and including 1500 psia and 550°F. The profile data corresponding to top-view conditions were taken for the velocities of 20 and 30 fps. This completes the program for the 0.500-in. channel height, contingent upon successful developing and printing of the negatives. The density data for 20 fps were processed through the state of vapor-volume calculation. (auth)

5526

THE STABILITY OF PLANE POISEUILLE FLOW. L. H. Thomas. *Phys. Rev.* **91**, 780-3 (1953) Aug. 15. (cf. NSA 6-4487)

The problem of the stability of plane Poiseuille flow to small disturbances leads to a characteristic value problem for the Orr-Sommerfeld equation with given boundary conditions. It happens that negative values of the imaginary parts of the characteristic numbers, which indicate instability, are small, at any rate over the region here investigated, and considerable accuracy is required to establish them, while the Reynolds numbers for which they occur are large. In this paper the fourth-order differential equation is replaced by a difference system of the same order with a truncation error involving the eighth derivative, so that the error is sufficiently small with a reasonably large interval. The resulting system of linear algebraic equations is solved by direct Gaussian elimination, which avoids the difficulties due to rapid exponential growth of error for high Reynolds number which beset the standard integration procedure. The characteristic value is obtained for a range of Reynolds numbers and wavelengths of the disturbance, and the critical Reynolds number found to be 5780 for wavelength 3.062 times the width of the channel. A detailed discussion of the accuracy of the work is given for the (unstable) case of wavelength π and Reynolds number 10,000, and a table of the profile of the disturbance is given for this case. (auth)

VACUUM SYSTEMS

5527

A METAL VACUUM VALVE. G. M. van Koppen. *Appl. Sci. Research B3*, 141 (1953).

A 3-way valve with O-rings for all seals is described. After 5000 revolutions, the O-rings did not need replacement. (E.S.)

WASTE DISPOSAL

5528

Defence Research Chemical Lab. (Canada)

APPLICATION OF DIFFUSION THEORY TO DISPERSION OF STACK GAS IN THE ATMOSPHERE. Morris Katz. Sept. 1952. 37p. (DRCL-110)

A considerable mass of data on measured ground concentrations of SO_2 in the Trail, B. C., and Sudbury, Ont., smelter areas have been utilized to test the atmospheric-diffusion theories of Sutton and of Bosanquet and Pearson. Effective stack heights have been employed which take into account the rise of the smoke above the source in various wind speeds due to the velocity and temperature of the gases issuing from the stack. Data are also presented on the ver-

tical distribution of smoke in the Sudbury area from gas samples collected by apparatus transported at various altitudes in aircraft flights. It is clear that the Bosanquet-Pearson equation of diffusion cannot apply to these cases. Good correlation between predicted and measured gas concentrations is obtained by application of Sutton's diffusion theory. (auth)

5529

Knolls Atomic Power Lab.

SOLID WASTE DISPOSAL AT THE KNOLLS ATOMIC POWER LABORATORY. R. E. Larson and R. H. Simon. June 15, 1953. 25p. (KAPL-936)

Segregation of high-level from low-level radioactive wastes at KAPL is the basis for handling contaminated solid wastes. This method allows the slightly contaminated wastes which form the great bulk of the material to be handled by inexpensive methods. A comparison of baling and incineration, both of which have been used at KAPL, showed that baling was a simpler operation, had a lower operating cost, and involved a much smaller capital investment. Consequently, baling is used to reduce the volume of the compressible wastes. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

5530

Langley Aeronautical Lab., NACA

CHARTS RELATING THE COMPRESSIVE BUCKLING STRESS OF LONGITUDINALLY SUPPORTED PLATES TO THE EFFECTIVE DEFLECTIONAL AND ROTATIONAL STIFFNESS OF THE SUPPORTS. Roger A. Anderson and Joseph W. Semonian. Aug. 1953. 54p. (NACA-TN-2987)

The stability of a plate under edge compressive stress is analyzed in terms of the deflectional and rotational stiffnesses of one or more longitudinal lines of support between the plate side edges. The results are presented in the form of charts which make possible the determination of the compressive buckling stress of plates supported by members whose stiffness may or may not be defined by elementary beam bending and twisting theory but yet whose effective restraint is amenable to evaluation. The deflectional and rotational restraint provided by longitudinal stiffeners and full-depth webs is discussed, and numerical examples illustrate the application of the charts to the design of wing structures. (NACA)

CERAMICS AND REFRACTORIES

5531

Lewis Flight Propulsion Lab., NACA

INFLUENCE OF STRUCTURE ON PROPERTIES OF SINTERED CHROMIUM CARBIDE. H. J. Hamjian and W. G. Lidman. June 1952. 21p. (NACA-TN-2731)

An investigation was conducted to study the influence of structural variations on the properties of Cr carbide sintered under pressure. The results show that the room-temperature strength and hardness are influenced by the stages of sintering, which are defined by grain size and by the number, size, location, and shape of pores. The extent to which sintering has progressed during the second stage when densification occurs and the sintering conditions which will yield optimum room-temperature strength can be determined from hardness. It was found that coarse-grained structures are detrimental to room-temperature strength.

On the basis of limited data, coarse-grained structures may not be detrimental at elevated temperatures. (auth)

CORROSION

5532

EMISSION OF PHOTOGRAPHICALLY ACTIVE PARTICLES IN THE ATMOSPHERIC CORROSION OF METALS. I. L. Roikh. Translated from Doklady Akad. Nauk S.S.S.R. 63, 119-22(1948). 6p. (AEC-tr-1603)

The results of experimental research on the kinetics of the emission of photographically active particles in the corrosion of Mg, Al, and Zn are presented. The particles are emitted only after the removal of the protective oxide film; otherwise no photographic effect with the metals is obtained. This indicates that the particle emission is connected with the process of atmospheric corrosion. There was found to be a definite relationship between the optical density due to any given quantity of photographically active particles emitted by the metal and the thickness of the oxide film. With the passage of time there was found to be a decrease in the rate of blackening and in the rate of thickening of the oxide film. The kinetic curve of emission of the photographically active particles also serves to characterize the progress of atmospheric corrosion. (J.E.D.)

5533

TEMPERATURE DEPENDENCE OF THE EMISSION OF PHOTOGRAPHICALLY ACTIVE PARTICLES IN THE ATMOSPHERIC CORROSION OF MAGNESIUM AND ZINC. I. L. Roikh and F. E. Mazaev. Translated from Doklady Akad. Nauk S.S.S.R. 72, 335-8(1950). 6p. (AEC-tr-1604)

The effect of temperature on the emission of photographically active particles in the atmospheric corrosion of Mg and Zn is presented. A study of the mechanism and relationships involved is made. It was found that the emission of the active particles is due to the corrosion of the metals, and the simplicity and relatively high sensitivity of the photographic method of studying the corrosion is illustrated. (J.E.D.)

5534

THE CORROSION RESISTANCE OF ZIRCONIUM AND ZIRCONIUM ALLOYS. Lex B. Golden. In "Zirconium and Zirconium Alloys." Cleveland, American Society for Metals, 1953. (p.305-26).

The results obtained with Zr exposed to the corrosive action of various concentrations of inorganic acids and salts and organic acids are summarized. The relative corrosion resistance of arc-melted and induction-melted Zr is discussed, as well as the corrosion resistance of various Zr alloys. These tests were made at several temperatures and under different conditions of aeration. (auth)

GEOLOGY AND MINERALOGY

5535

Pennsylvania State Coll.

PETROGRAPHICAL INVESTIGATIONS OF THE SALT WASH SEDIMENTS; PROGRESS REPORT, MARCH 1 TO JUNE 1, 1953. John C. Griffiths, D. W. Groff, and J. S. Kahn. Issued June 1953. 55p. (RME-3054)

The results, with a brief discussion of their implications, of two aspects of the petrographical investigations into the Salt Wash Sediments are reported. The first part deals with the results of bulk density determination by Hg balance of 161 samples from the cores of Well 155C, Bull Canyon. The second part of the report describes preliminary investigations into the nature of "limonite spots," and the spots are identified as an Fe bearing carbonate losing its ferrous Fe which is oxidized, hydrated, and precipitated as brown stain on the carbonate. The distribution of these spots is dis-

cussed. On the basis of the bulk density variation (essentially a reflection of degree of cementation) and the distribution of limonite spots and ore, it is suggested that the sandy sediments are zoned—the ore being surrounded by a zone of limonitic carbonate and this in turn being flanked by clear crystalline calcite. Non or partially cemented sandstones are associated with the ore and limonite zones and do not occur near the margins of thick sands which are completely cemented. (auth)

5536

Statistical Lab., Iowa State Coll.
SOLUTION TO A SIMPLE DRILLING PROBLEM. Howard Jespersen. July 24, 1953. 30p. (RME-3055)

A study is made of the drilling necessary to determine the size of an underground ore body. Economic considerations require that the ore body exceed some critical size if the mining of the ore is to be profitable. A procedure is discussed for determining the location of the holes to be drilled and for making the final assertion as to whether or not the ore body exceeds the critical size. (J.E.D.)

5537

Statistical Lab., Iowa State Coll.
ANNUAL REPORT FROM AUGUST 1, 1952 TO JULY 31, 1953. M. R. Mickey. July 18, 1953. 14p. (RME-3056)

The objective of the work of this project is the application of statistical methods and concepts to problems involved in the programming of exploration drilling operations. This report summarizes the work performed during the past year on the following three problems: the problem of formulating a conceptual framework from which to consider the problems involved; the local problem of developing an ore body once an ore hole is found; the problem of construction of favorability maps for a drilling project area. Since no field application of ideas developed has been made, no concrete recommendations are given. (auth)

5538

Division of Raw Materials, AEC
URANIUM POSSIBILITIES IN TURKEY. Edward K. Judd. Issued July 1953. 24p. (RME-4017)

A survey of publications dealing with the mineral resources of Turkey reveals that the most important deposits of Fe and Cr and some of those of Cu are related to intrusives of basic to ultra-basic character, such as have not been known to afford U elsewhere. Granites and quartz-diorites, however, are not lacking. The ore deposits associated with them are mainly of Pb and Zn. Prospecting in the vicinity of these more acidic intrusives, especially if veins of Cu-Ag or Co ore should be discovered, might prove worthwhile. One specific occurrence of a U mineral has been recorded: a specimen of pitchblende with two attached and previously unknown alteration minerals, said to have come from the vicinity of Adrianople. No further and no more detailed description of the locality has been found during the 100 years since the first announcement. This report deals almost entirely with those metallic ore deposits associated with magmas other than the ultra-basic, thereby purposely excluding deposits of Fe ore, chromite, emery, meerschau, etc., products for which Turkey is particularly notable. The localities believed to be those most likely to repay systematic radiometric exploration for U are listed. (auth)

5539

Division of Raw Materials, AEC
ROUTINE TESTING OF SAMPLES FOR RADIOACTIVITY IN MILLS AND ASSAY OFFICES IN THE UNITED STATES. A PROGRESS REPORT. Muriel Mathez. Aug. 1953. 4p. (RME-4025)

A program was initiated to provide a means of monitoring routinely for radioactivity diverse types of ore samples that might not otherwise be considered as a possible source of

U. For this purpose, automatic scanning devices were installed in custom smelters, mills, and assay offices in various areas. A preliminary design of an instrument for detecting the radioactivity is presented. (J.E.D.)

5540

Division of Raw Materials, AEC
PRELIMINARY REPORT ON URANIUM-BEARING DEPOSITS IN MOHAVE COUNTY, ARIZONA. Olin M. Hart and D. L. Hetland. Issued June 1953. 48p. (RME-4026)

Preliminary studies of the Wallapai Mining District and selected properties in the Maynard and Greenwood Mining Districts, Mohave County, Arizona, were made to determine the extent of U mineralization. All the U properties examined are of the vein type and are believed to be of mesothermal origin. Brecciation and porosity of the veins appear to be controlling factors in the concentration of U minerals from the ore-bearing solutions. Although the U minerals present in these districts have not been specifically identified, they appear to be mostly primary with very minor occurrences of secondary products. One exception is the State mine in the Greenwood District, where secondary minerals predominate. The known U deposits are not sufficient in quantity or grade to justify their operation as U producers alone under present conditions. (auth)

5541

Division of Raw Materials, AEC
RECONNAISSANCE OF THE ASPEN AREA, INCLUDING THE SMUGGLER MINE, PITKIN COUNTY, COLORADO. F. S. Boyd, Jr. and C. P. Bromley. Issued Jan. 30, 1953. 23p. (RME-4031)

A radiometric reconnaissance of sediments, igneous rocks, and mines in the Aspen area revealed no significant radioactivity except in the Smuggler mine near Aspen. Uranium in the Smuggler mine occurs in a fault breccia composed of dolomitic limestone blocks and fragments in a carbonaceous shale matrix. The U is found in the matrix; associated with it are variable amounts of Pb and Zn sulfides and Ag sulfides and sulfo-salts. The major U mineral is believed to be primary pitchblende, but positive identification has not been made. Some U is also found in secondary barite that contains free Ag and in association with incrustations of goslarite (a hydrous zinc sulfate). (auth)

5542

Division of Raw Materials, AEC
PRELIMINARY DRILLING AT THE NASH CAR AREA, WHITE CANYON DISTRICT, SAN JUAN COUNTY, UTAH. Paul C. deVergie. Issued Mar. 10, 1953. 13p. (RME-4032)

The investigational drilling of the Nash Car claims was part of a program to evaluate several mineralized paleostream channel exposures in the Shinarump conglomerate of the White Canyon area. Drilling was directed toward tracing the channel, determining its lithologic and structural characteristics, and locating ore. The mineralized channel of the Shinarump was found to be a continuous feature which was traced for 2000 ft behind the outcrop. Evidence from the study of similar channels in the White Canyon district indicates that the channel probably continues farther. Within the channel and up to at least 2000 ft behind the outcrop, the lower sandstone unit is mineralized and in places contains material of ore grade. This zone ranges from a few inches to 7 ft in thickness and has an average width of about 300 ft. Drilling procedures were at no time directed toward blocking out ore, and no estimate of ore reserves can be made from the available data. (J.E.D.)

5543

Geological Survey
AN IMPROVED TUBULAR ELECTRIC FURNACE FOR THE

CLOSED-TUBE DISTILLATION OF OIL FROM OIL SHALE.

Frank Cuttitta and Charles A. Kinser. May 1953. 15p. (TEI-326)

The single-unit, tubular electric furnace used in the closed-tube distillation of oil from oil shale has been modified to increase its capacity, compactness, ruggedness, and general utility. With this furnace four oil distillations can be completed in the same length of time formerly required for one. The new furnace gives results similar to those obtained by the single-tube furnace. When used with a variable autotransformer, the temperature of the Al-core furnace can be controlled from room temperature to 550°C. Detailed shop drawings are given for the construction of the furnace. (auth)

5544

Geological Survey

IDENTIFICATION AND OCCURRENCE OF URANIUM AND VANADIUM MINERALS FROM THE COLORADO PLATEAUS.

A. D. Weeks and M. E. Thompson. Apr. 1953. 69p. (TEI-334)

A report on the identification and occurrence of U minerals of the Colorado Plateaus, containing physical properties, x-ray data, and in some instances results of chemical and spectrographic analysis of 24 U and 17 V minerals is presented. A table giving the optical properties of U minerals and a list of locations of mines from which the minerals have been identified is included. (J.E.D.)

METALS AND METALLURGY

5545

North American Aviation, Inc.

INTERSTITIAL AND VACANCY MIGRATION IN Cu_3Au AND COPPER. J. A. Brinkman, C. E. Dixon, and C. J. Meehan. June 1, 1953. 29p. (NAA-SR-249)

Several experiments are described which have been interpreted as involving the introduction of vacancies in excess of the normal thermal equilibrium number in Cu and the Cu solid solution Cu_3Au . The annealing characteristics of these vacancies have been studied by observing enhanced ordering rates in Cu_3Au and by analyzing the annealing of resistivity changes in Cu. This analysis shows that an annealing state exists which involves volume diffusion of a defect to infinite sinks. From the results of these investigations it has been possible to interpret activation energies measured by other authors as the activation energies for migration of interstitials and vacancies. Arguments are given for the following assignment of migration activation energies in Cu: vacancies, 1.19 eV; interstitials, 0.7 eV. (auth)

5546

Battelle Memorial Inst.

PRODUCTION OF SOUND DUCTILE JOINTS IN MOLYBDENUM; PROGRESS REPORT. M. I. Jacobson, D. C. Martin, and C. B. Voldrich. July 17, 1953. 26p. (NP-4718)

An investigation of the production of sound and ductile welded joints and brazed joints in Mo is presented. A slotted-type tension specimen was developed for determining the shear strength of brazed joints. Ten slotted-type tension specimens were induction-brazed in A and tested at 1800°F. The results showed that the best noncobalt-base alloy was inconel, which produced a brazed joint having a shear strength of 18,800 psi. The best Co-base alloy was Haynes Alloy 25, which produced a brazed joint having a shear strength of 14,250 psi. These two alloys were used to prepare joints for 100-hr stress-rupture tests. The 100-hr stress-rupture strength of joints brazed with Haynes Alloy 25 was 4500 psi. A flux was developed for oxyacetylene brazing that gave good protection from oxidation in the range 800 to 2600°F. This flux was easily removed by washing in hot water and wire brushing. (auth)

5547

Case Inst. of Tech.

VARIATION OF THE ADIABATIC ELASTIC CONSTANTS OF ALUMINUM WITH TEMPERATURE. T. R. Long and Charles S. Smith. July 1953. 22p. (NP-4727; Technical Report 12)

The elastic constants of a single crystal of Al have been measured by the pulsed ultrasonic technique in the temperature range from 80 to 300°K. It was found that all of the elastic constants decreased linearly with increasing temperature in this range. The values of the elastic constants at room temperature (298°K) were found to be: $C_{44} = 0.2848$, $C' = 0.234$ and $K^{-1} = 0.770$, all expressed in units of 10^{12} dyne cm^{-2} . A thermodynamic argument is used to separate the effects of the volume change through thermal expansion from the other effects of temperature on the elastic constants. This argument shows that the change with temperature cannot be explained solely in terms of the change in volume because there is an explicit dependence of the constants on temperature. This explicit dependence is different in both magnitude and direction for the shear constants C' and C_{44} . (auth)

5548

Massachusetts Inst. of Tech.

LOCAL ATOMIC ARRANGEMENTS IN GOLD-NICKEL ALLOYS. P. A. Flinn, B. L. Averbach, and M. Cohen. July 15, 1953. 33p. (NYO-3820; Technical Report 17, Scope II; DIC 6832)

The local atomic arrangements in Au-Ni alloys are determined as a function of composition by observations of diffuse x-ray scattering. Measurements are made at -190°C on alloys quenched from above the solubility gap, there being experimental evidence to show that the high-temperature atomic configurations can be retained on quenching. The x-ray data reveal that these alloys exhibit a preference for unlike neighbors above the solubility temperature, and have short-range order analogous to that in Cu-Au alloys. The sizes of the atoms in the solid solutions are also measured from the diffuse scattering. The Au atom in solution is smaller than in the pure metal but larger than the average atomic dimension calculated from the lattice parameter of the solution. Correspondingly, the Ni atom in solution is larger than in the pure metal but smaller than the average atomic dimension of the solution. Moreover, the size of each atom varies with the composition of the solution. (auth)

5549

ON THE RUPTURE OF METALS BY SLIPPING. N. F. Lasko. Translated by S. Klemantaski from *Zhur. Tekh. Fiz.* 20, 884-7(1950). 9p. (AEC-tr-1560)

Several cases of rupture are examined which show that slip formation, which is responsible for the hardening of the metallic lattice, leads ultimately to the disintegration of the lattice, to the weakening of the bond along the slip planes, and "prepares" the lattice for rupture, which sets in on the separation of one part of the lattice from the other (when the metallic bond is broken). (auth)

5550

THE THEORY OF THE ELASTIC CONSTANTS OF BINARY SOLID SOLUTIONS WITH A CUBIC LATTICE. A. N. Orlov. Translated by R. A. Acton Taylor from *Zhur. Eksptl' i Teoret. Fiz.* 21, 1090-5(1951). 6p. (AEC-tr-1599)

The dependence of the elastic constants of a solid solution on its composition is computed from principles calculated from a model. (auth)

5551

THE STEPPED STRESS/STRAIN CURVE OF SOME ALUMINIUM ALLOYS. N. Krupnik and Hugh Ford. *J. Inst. Metals* 81, 601-15(1953) Aug.

With a view to establishing basic yield-stress curves, tensile tests were made with four Al alloys pulled at constant rates of either loading or straining. It was found that alloys which showed stepped yielding over the whole

stress/strain curve under normal testing conditions could be made to give a smooth stress/strain relation only under special test conditions, viz. (1) very low rates of stress and (2) constant rates of strain. The smooth curve, where it was obtained, appeared to agree well with the envelope of the stepped curves for the same material, the steps being deviations below the basic curve. In these tests, the large initial type-A yield did not occur, and in this case the type-B steps show a gradually increasing size from the first perceptible plastic deformation until final fracture. It was found that any sudden disturbance of the testing machine caused an otherwise smooth yield curve to break down into steps, and this may explain some of the irregularities observed in tensile tests on these alloys with normal testing methods. (auth)

5552

INFLUENCE OF TEMPERATURE ON THE CORROSION SPEED OF ALUMINUM AND SOME ALUMINUM ALLOYS. G. V. Akimov and V. V. Romanov. *Doklady Akad. Nauk S.S.S.R.* **91**, 281-3(1953) July 11. (In Russian)

Cu-free Al and the alloys duralumin and magnalium were investigated for the effect of temperature on the corrosion rate. The samples were in the shape of rods and were corroded with NaCl at pH 6, NaCl + HCl at pH 3 and pH 1, and NaCl + NaOH at pH 11. The rate of corrosion was graphed against temperature for each of the corrodents. (J.S.R.)

5553

ELECTRODEPOSITION OF URANIUM OXIDE ON ALUMINUM. Carl R. Wilson and A. Langer. *Nucleonics* **11**, No. 8, 48(1953) Aug.

A process for the successful electrodeposition of UO_2 coatings on Al is described. Thicknesses up to 3 mg/cm^2 are achieved by sub-coating the Al with Zn. The films produced are smooth and sufficiently adherent to withstand considerable shock. (K.S.)

5554

EFFECT OF COMPOSITION AND HEAT-TREATMENT ON YIELD-POINT PHENOMENA IN ALUMINUM ALLOYS. V. A. Phillips. *J. Inst. Metals* **81**, 649-61(1953). Aug.

Discontinuous yielding has been studied in commercial Al and some common alloys not containing large amounts of Mg. The initial yield found in fine-grained Al-Mg alloys was weak or absent in the present materials, even when the grain-size was fine, but strain-aging effects were present, the strength of which depended on the composition and heat-treatment. These effects gave rise to stepped stress/strain curves at room temperature. The increase in flow stress produced by aging after straining at a low temperature can be separated into two parts, σ_s , a transient increase which disappears as soon as further deformation takes place, and σ_p , a permanent increase which raises the level of the whole subsequent stress/strain curve. σ_s is attributed to locking of dislocations by a Cottrell mechanism, σ_p to normal age-hardening, which in some cases is accelerated by the prior strain. (auth)

5555

YIELD-POINT PHENOMENA AND STRETCHER-STRAIN MARKINGS IN ALUMINUM-MAGNESIUM ALLOYS. V. A. Phillips, A. J. Swain, and R. Eborall. *J. Inst. Metals* **81**, 625-47(1953). Aug.

The formation of stretcher-strain markings in Al-Mg alloys has been correlated with the stress/strain diagram. There is an initial yield, similar to that of steel, and the deformation associated with this, which is a shear, produces markings resembling Lüders markings in steel. In pressing, markings of this type (type A) occur in lightly strained regions and constitute a serious defect. This type-A yield is characteristic of the fine-grained, recrystallized

alloy. It is absent in coarse-grained materials, and is also absent in materials which have been worked, even if subsequently aged. In a tensile test at room temperature, there are many subsequent yields. These (type-B) yields are shown to be due to strain-aging during the test. The associated deformation is confirmed to be a symmetrical thinning without shear, and the markings do not become conspicuous unless a heavy stretch is applied. The yields produced by strain-aging are hardly sensitive at all to changes in grain-size and still occur in material which does not show type-A yielding. The type-A yield point is attributed to the blocking of the propagation of slip from grain to grain, owing to the presence of a high concentration of Mg in solution at the grain boundary. Strain-aging and the type-B yielding are attributed to a simple Cottrell mechanism, with Mg as the most important solute element. (auth)

PHYSICS

5556

Los Alamos Scientific Lab.

AN EXPERIMENTAL METHOD TO DETERMINE EQUATION OF STATE DATA FOR SOLIDS BY SHOCK WAVE MEASUREMENTS. Russell H. Christian and John M. Walsh. [nd] Decl. July 15, 1953. 18p. (AECD-3540; LADC-1421)

Equation-of-state data are derivable from measurements of the velocity of a plane shock-front through a plate and the corresponding velocity of the free surface after the shock has traversed the plate. The present experimental method employs a high-explosive lens system to generate the plane shock. Velocities are recorded by a high-speed sweep camera with precisions of the order of 0.5%. A series of such experiments determines the experimental shock velocity vs. free-surface-velocity curve for a given solid. The method permits measurements using shocks in the pressure region of approximately 100 to 400 kilobars. The lower limit is defined by the onset of the familiar "elastic-plastic" waves for low-pressure disturbances, in lieu of stable shocks. The upper limit is determined by the maximum shock strengths attainable with high explosives. Both limits are subject to variation, being dependent upon the material. Experimental data have been obtained for Al, Cu, Zn, and commercial lucite. (auth)

5557

[Research Foundation], Ohio State Univ.

SUPERCONDUCTIVITY OF TECHNETIUM. John G. Daunt, Ohio State Univ. and J. W. Cobble, Oak Ridge National Lab. [1953] 5p. (AECU-2612)

A powdered 0.1027-g sample of Tc of at least 99.9% purity was found to be strongly diamagnetic from 0.9 to 4.2°K . The average value of the superconductive transition temperature in zero magnetic field was found to be 11.2°K . In constant external magnetic fields up to 209 gauss similar transitions were observed. The very high transition temperature observed was in accord with Daunt's empirical correlation among superconductors. (E.S.)

5558

Brookhaven National Lab.

PHOTOGRAPHIC PLATE WITH CONSTANT CONTRAST. Morris Slavin. [1953] 3p. (BNL-1520)

Design of a three-layer photographic plate is reported which gives a spectral region of constant contrast extending from the visible to the vacuum ultraviolet. The plate permits a choice of properties from high speed, low resolution to slow speed, high resolution. (C.H.)

5559

Bell Telephone Labs., Inc.

LOW-DRAIN AUDIO OSCILLATOR; FINAL REPORT ON TASK 1. D. E. Thomas, L. B. Valdes, W. J. Pietenpol, R. M. Ryder, and C. Flannagan. June 1, 1952. 44p. (NP-4722)

Attention is directed to the development of a low-drain audio oscillator circuit using an M1725 transistor. Circuit design and stability characteristics are outlined, together with an equivalent circuit analysis. The development of an M1768 transistor (modified M1725) for low-drain, high-efficiency, low-frequency applications is described. Temperature and structural effects are discussed. Static characteristics and specifications are given. (K.S.)

5560

FUNDAMENTAL EQUATIONS OF THE RHEOLOGY OF A VISCO-PLASTIC MEDIUM. N. V. Tyabin. Translated by Allen from *Kolloid. Zhur.* 13, 56-63(1951). 12p. (AEC-tr-1610)

New equations are established for the rheology of a visco-plastic medium and the flow of a visco-plastic liquid. Properties of solid visco-plastic bodies and of liquid dispersed systems which possess visco-plastic characteristics are explained by the action of the force of gravity, and a conception is introduced of a critical height of form retainability which demarcates the solid and the liquid state of a visco-plastic medium. The law of distribution of speeds during flow of a visco-plastic medium on an inclined surface is obtained. (L.M.T.)

AEROSOLS

5561

AN AEROSOL ANALYZER. Joseph I. Masters. *Rev. Sci. Instr.* 24, 586-88(1953) Aug.

Described is a simple device for measuring the total mass and total charge of a powder cloud. The instrument consists of a sensitive electrometer circuit and a metallic collection chamber. The powder is collected on a filter paper sealed between two Al tubes which, if their length is three times greater than their diameter, provides sufficient shielding of the charge collected on the filter paper to justify assumption of an "Ice Pail." The shielding error is less than 0.5%. A null-reading circuit is used with a Cenco electrometer. The necessary counter voltage for the null-reading circuit is supplied by a potentiometer circuit, and a vacuum-tube voltmeter is used to measure the voltage. Because it is desired to obtain explicitly the mass and charge of a given cloud of particles rather than the ratio of charge to mass, enough mass must be collected for weighing and, in addition, the total charge measured. This is to be accomplished without disturbing appreciably the normal flow rate of powder from the aerosol generator. (auth)

COSMIC RADIATION

5562

THE THEORY OF V-PARTICLES. Ken-ichi Ono. *Progr. Theoret. Phys. (Japan)* 9, 524-8(1953) May.

In order to explain the inconsistency between the production and the decay probabilities of V^0 , it is proposed to assume that V^0 has an unknown degeneracy. From the lifetime and the production rate of V^0 the state density of V^0 is estimated to be of the order $\sim 10^{10}/m_{\pi}c^2$, and from the dispersion of the Q values for the decay of V^0 the total number of the internal states of V^0 is estimated to be very roughly of the order $\sim 10^{10}$. From these results the cross section for the production of V^0 by the nucleon-nucleon collision is calculated. (auth)

5563

THE PROBLEM OF DELAY AMONG PARTICLES APPER-

TAINING TO COSMIC RAYS. Anatole Rogozinski. *J. phys. radium* 14, 438-44(1953) July-Aug.-Sept. (In French)

After a brief examination of the problem of delay, which can appear among particles of high energy issuing from the same mother particle, a more detailed study is made of charged particles which have not lost their energy by ionization. The delay which is established between two particles of mass M is defined by the difference between the time which it takes to pass over the same distance. The delay can attain any value. However, since the particles are propagated in an absorbent medium, the delay tends to reach a well-defined limit which is the initial energy of the particle. It is shown that the maximum delay is given by $(\Delta t)_{\max} \approx 0.6 \frac{E_0}{cK_{\min}}$, where $E_0 = Mc^2$ represents the rest energy of the particle and K_{\min} the minimum dose of energy/cm of distance in a given homogeneous medium. For example, in the case of protons traversing different absorbent mediums, the values of $(\Delta t)_{\max}$ for air, water, Al, and Pb are 8.3×10^{-8} , 9.7×10^{-9} , 4.5×10^{-9} , and 1.6×10^{-9} sec, respectively. The values of $(\Delta t)_{\max}$ for electrons are of the order of 10^{-9} sec for air and 10^{-12} sec for the others. If the particles appertaining to a jet show a delay longer than that indicated above, this delay is sufficient proof of the existence of heavy particles in the jet. The relation between $(\Delta t)_{\max}$ and the mass M can serve as a basis for a method of spectrography of the mass of high energy particles. (truth)

ELECTRICAL DISCHARGE

5564

STRATIFIED HIGH FREQUENCY DISCHARGE. Kh. A. Dzherpetov and A. A. Zaitsev. *Doklady Akad. Nauk S.S.S.R.* 89, 825-8(1953) Apr. 11. (In Russian)

The conditions for the formation of stationary and mobile layers in h-f discharge were investigated. The discharge tubes were filled with A or Ne. For symmetrical discharge the electrodes, placed inside the tube, were disks of equal size. For asymmetrical discharge one of the electrodes was a disk and the other was either a spiral wire or a simple wire. These electrodes were outside the tube. Stationary layers are formed by a diffusion process in symmetrical discharge. The most striking characteristic of stratified h-f discharge is that the appearance or disappearance of each layer by change of the distance of the electrode is intermittent. Disturbance of the symmetry can be caused by different methods. If the external electrode is moved from the end of the tube to the middle, the intensity shifts from the middle to the end of the tube. If the electrodes are different in form or size, the discharge will be non-symmetrical. (J.S.R.)

ELECTRONS

5565

PRODUCTION OF HIGH-ENERGY ELECTRON PAIRS BY NEGATIVE PIONS IN NUCLEAR COLLISIONS. Marcel Schein, Joseph Fainberg, D. M. Haskin, and R. G. Glasser. *Phys. Rev.* 91, 973-80(1953) Aug. 15.

Nuclear plates were exposed to negative pion beams of the 450-Mev Chicago cyclotron to search for high-energy pairs produced in nuclear collisions. The seven pairs found exhibit the following characteristics: (a) the mass of the particles is less than $10 m_e$, so the pairs probably consist of electrons; (b) the energies of the pairs range from 22 to 205 Mev; (c) the angles between the particles of the pair range from 0.3 to 25.9° ; (d) the distance from the star to the point of origin of the pair—"gap"—was definitely less than 2μ (determined by reprojection); (e) the angle between the center of mass of the pair and the direction of the incoming

pion was 125° with a spread of $\pm 15^\circ$. The most reasonable assumption seems that they are due to the process: $\pi^0 \rightarrow e^+ + e^- + \gamma$ first discussed by Dalitz. If this explanation should hold, then from the measured gaps the lifetime must be definitely less than 4.8×10^{-15} sec. However, if all the seven pairs were due to the proposed decay scheme of the π^0 meson, the probability of the observed angular distribution (e) is certainly less than 2×10^{-5} . A possible explanation for the observed effect is that the pair may tend to line up in direction with the neutral pion direction. (auth)

5566

THE SPECIFIC PROBABLE IONIZATION OF ELECTRONS OBSERVED WITH A WILSON CLOUD CHAMBER. Robert H. Frost and Carl E. Nielsen. *Phys. Rev.* **91**, 864-5(1953) Aug. 15.

The specific probable ionization of electrons has been measured for the energy range in which it is a rapidly varying function of velocity by counting the droplets along cloud-chamber tracks. The electron momenta have been determined by the use of a magnetic field perpendicular to the direction of photography, permitting counting along appreciable lengths of the helical tracks of slow electrons. The dependence of the measured specific ionization upon velocity agrees within the experimental uncertainty with that predicted by the Bethe-Bloch theory. The ionization in the vapor has been determined experimentally, permitting the determination of the minimum ionization in the dry gases at standard conditions as 46.1 ± 2.2 ions per cm in air, 6.48 ± 0.34 in H_2 , 8.13 ± 0.51 in He, and 53.1 ± 2.8 in A, where the statistical probable errors are indicated. These values are compared with the average ionization found for cosmic-ray mesons by Hazen and Skolil. The theoretical minimum rates of energy loss divided by these values give values of the average energy loss per ion pair of 31.2 ± 1.5 ev for air, 37.2 ± 2.0 for H_2 , 26.0 ± 1.6 for He, and 27.9 ± 1.5 for A. (auth)

5567

THE MECHANISM OF SELF-SUSTAINED ELECTRON EMISSION FROM MAGNESIUM OXIDE. Dietrich Dobischek, Harold Jacobs, and John Freely. *Phys. Rev.* **91**, 804-12 (1953) Aug. 15.

Thin films of MgO , under the influence of an electric field, have been observed to emit extremely large secondary-emission currents when bombarded with electrons. This current has been found to be exponentially dependent upon the electric field in the oxide film, and under certain conditions, to persist for many hours after the bombarding current has been cut off. Experiments have shown that the enhanced emission is due to the fact that the surface acquires a positive charge during bombardment, thereby creating an intense field in the thin film. Electrons released in the film by internal ionization are then accelerated by the field and cause further ionization, so that eventually an electron avalanche ensues. It has been found that there are two components of the enhanced electron emission. The first component is a true field-enhanced secondary-emission effect similar to that described in previous work. The second component is a self-sustained electron emission. This self-sustained electron emission is produced by the same type of avalanche effect, except that the internal ionization of the dielectric is initiated by electrons produced from within the material rather than by electrons bombarding the material from an external source. (auth)

GASES

5568

Hanford Works
CALCULATED THERMAL CONDUCTIVITIES OF He-CO₂, He-Ne, AND He-N₂ MIXTURES. J. M. Davidson. July 20,

1953. 13p. (HW-28766)

In HW-21741, an erroneous value for the Sutherland constant of He was used in the calculation of thermal-conductivity values for He-CO₂, He-Ne, and He-N₂ mixtures. The thermal conductivities of the mixtures have been recalculated for 273, 400, 600, and 800°K. The corrected values supersede those published in HW-21741. (auth)

INSTRUMENTS

5569

Ames Lab.
A FAST SWEEP GENERATOR. C. Harper and E. Sanford. May 19, 1953. 16p. (ISC-351)

A generator of a high-speed sweep voltage for cathode-ray tubes is described. The circuit features a wide range of continuously variable sweep speeds and a linear 1500-v balanced output. (auth)

5570

Los Alamos Scientific Lab.
THE MODEL 15 100 CHANNEL PULSE HEIGHT ANALYZER. Richard D. Hiebert, Gerald L. Evans, and Richard J. Watts. Apr. 1953. 25p. (LA-1565)

A multi-channel pulse-height analyzer of the Wilkinson type, with good linearity and stability, is described. Inasmuch as channel count is fed directly to registers, the speed of analysis is slow and the instrument makes use of a pulse-sampling scheme to analyze pulses at no shorter time intervals than 60 msec. Channel width is nominally 1 v per channel, but greater resolution has been attained by preceding the analyzer with a gain-of-five window amplifier to give 0.2-v channels. The instrument is particularly suited to experiments requiring high stability of analysis of pulses falling in a wide spectrum at a relatively slow rate. (auth)

5571

Office of Basic Instrumentation, National Bureau of Standards
CHARACTERISTICS OF TWO TYPES OF TEMPERATURE COMPENSATED RESISTANCE STRAIN GAGES. D. W. Hinze, D. Namkoong, and W. R. Campbell. June 1953. 19p. (NBS-2552)

Tensile calibrations and measurements of gage output vs. temperature were made on SR-4 gages of types EBD-1S and EBD-1D. Six gages of each type were calibrated for strains up to 0.0025 at temperatures ranging from 75 to 250°F. With the exception of two gages of type EBD-1S, calibration factors were within the tolerance set by the manufacturer. No significant variation of calibration factor with temperature was observed. The performance of the gages with respect to linearity, zero shift, and stability was generally improved by preloading. Eight EBD-1D gages and 9 EBD-1S gages attached to unstressed bars were subjected to varying temperatures in the range 0 to 300°F. Gage output, measured as apparent strain, for the EBD-1D gages on 24S-T Al alloy did not vary more than $\pm 50 \times 10^{-6}$ for temperatures between 50 and 280°F. Temperature sensitivity in this range for the EBD-1S gages on hot-rolled spring steel produced maximum variations in apparent strain of $\pm 100 \times 10^{-6}$. (auth)

5572

Radiation Lab., Univ. of Calif., Berkeley
PRECISION MEASUREMENT OF MAGNETIC INDUCTION WITH BISMUTH WIRE. H. B. Keller. June 9, 1953. 21p. (UCRL-2249)

The resistance of Bi wire is a function of temperature and magnetic induction, varying inversely with temperature. At low temperatures the resistance may be taken as a measure of magnetic induction. The magnetic induction may then be plotted directly vs. any convenient coordinate. (auth)

5573

APPARATUS FOR NUCLEAR MAGNETIC RESONANCE. H. S. Gutowsky, L. H. Meyer, and R. E. McClure. *Rev. Sci. Instr.* **24**, 644-52(1953) Aug. (cf. NSA 5-7037)

Apparatus and procedures are described for the high-resolution measurement of resonance shifts and for the observation of broad line shapes. Included are a discussion of magnet design and a summary of empirical results obtained in the construction and field homogenization of two large permanent magnets. Narrow, complex resonance lines, with components separated by as little as a milligauss, are resolved by a combination of homogeneous applied magnetic field, small samples, and slow-sweep field modulation. Broad absorption-line shapes are plotted at fixed frequency by a system incorporating a regenerative oscillator, a narrow band amplifier, a recording potentiometer, and an electronic control for varying the applied magnetic field linearly in time. A simple cryostat provides stable temperatures from 85 to 500°K. In the case of samples with short spin-lattice relaxation times, such as the metals, improved signal-to-noise ratios are obtained by adjusting the oscillator to super-regenerative operation and observing the frequency modulation associated with the dispersive component of the resonance. (auth)

5574

CIRCUIT FOR A RADIO-FREQUENCY SPECTROMETER. Joseph Gindsberg and Yardley Beers. *Rev. Sci. Instr.* **24**, 632-4(1953) Aug.

A circuit is described for amplitude stabilization of a regenerative detector for use in nuclear magnetic resonance experiments. A remotely located two-stage d-c amplifier converts variations in oscillator grid leak voltage into compensating changes in plate supply potential. The stabilizer circuit adds little stray capacity and does not appreciably affect the oscillator design. The level of oscillation is adjustable from zero to approximately 0.3 volt peak r-f signal at the detector grid. Once set, it remains essentially constant over the tuning range (4.8 to 6.3 Mc). A noise figure of 2 or better is obtained. Circuit parameters for the regenerative detector and the stabilizer are given. (auth)

5575

A REGULATOR FOR A 20- TO 250-KILOVOLT COCKCROFT-WALTON ACCELERATOR. Charles J. Cook and W. A. Barrett. *Rev. Sci. Instr.* **24**, 638-40(1953) Aug.

A regulator has been built to hold the accelerating potential of a Cockcroft-Walton accelerator to within 0.015% of any preset potential in the range of 20- to 250-kv. The regulator is a degenerative type where the error signal is amplified by a galvanometer-phototube d-c amplifier system which controls a variable impedance transformer in series with the high-voltage power transformer primary. The regulator is very simple to put into operation. Its action is independent of the potential desired; therefore the range of operation could easily be extended. (auth)

5576

THE CONSTRUCTION OF SMALL SOLENOIDS FOR THE PRODUCTION OF INTENSE MAGNETIC FIELDS. W. R. Myers. *J. Sci. Instr.* **30**, 237-8(1953). July.

The construction of some small solenoids is described, and their behavior in the production of intense transient magnetic fields of up to 250 kgauss is reported. With applied voltages of up to 14 kv from a 4.5 μ f condenser, none of the solenoids experienced either electrical or mechanical breakdown. (auth)

5577

A SIMPLE REPETITIVE TIMING CIRCUIT FOR SCALING UNITS. J. C. Jones. *J. Sci. Instr.* **30**, 253-4(1953) July.

A circuit designed to reduce the fatigue of manual switch-

ing and timing is described. The circuit will switch on a scaling unit for times up to 1 min and will then switch it off for a variable time during which the number of counts can be noted and the position of the counter changed. It will then reset the scaling unit and repeat the process indefinitely. (auth)

ISOTOPES

5578

Oak Ridge National Lab.

ELECTROMAGNETICALLY ENRICHED ISOTOPES: INVENTORY, MAY 31, 1953. C. P. Keim, C. E. Normand, and Boyd Weaver. Issued July 20, 1953. 44p. (ORNL-1568)

This inventory lists the isotopes which have been concentrated electromagnetically, along with the completed information on their enriched abundances and the element weights and product forms available in milligram quantities to users on AEC projects and in university and industrial laboratories. (auth)

5579

Radiation Lab., Univ. of Calif., Berkeley
SEPARATION AND ASSIGNMENT OF RADIOACTIVE ISOTOPES (thesis). Maynard Cornelius Michel. July 2, 1953. 54p. (UCRL-2267)

A time-of-flight mass spectrometer has been constructed for use as a separator for radioactive isotopes produced in cyclotron irradiations. This high-transmission instrument allows sufficient mass-separated activity to be collected to assign the mass numbers of such nuclides directly, in addition to providing pure samples of the given isotopes for the study of their decay properties. Mass assignments and separations have been made for Cs^{126} , Cs^{127} , Cs^{130} , Tl^{198} , Tl^{199} , Tl^{200} , Yb^{166} , Yb^{169} , Tm^{165} , Tm^{166} , Tm^{167} , Er^{160} , and Er^{161} , some of which are reported here for the first time. (auth)

ISOTOPE SEPARATION

5580

Carbide and Carbon Chemicals Co. (K-25)

RAPID ESTIMATES OF LIMITS FOR NET TRANSPORTS AND EQUILIBRIUM TIME. J. Shacter. Issued Aug. 3, 1953. 19p. (K-1044)

Equations are given which can be used to estimate ranges of operating time needed to achieve "steady-state" conditions. A binary, stagewise separation process is assumed. The case of startup is emphasized for enriching sections with a single product stream and a defined separation factor. It is shown that a final steady state can never be achieved without some relaxation in final production rate, during the transient period; that the final rate of approach to steady state at total reflux of an "ideal" cascade is approximately $\frac{1}{2}$ of its initial rate; and that a minimum-equilibrium-time cascade is generally a shorter and wider plant than the minimum-enriched-holdup plant, whether square or tapered (ideal). Large feed rates, fed near matching concentrations in the cascade, are suggested as a means of minimizing cascade equilibrium times. It is suggested that product removal be initiated as soon as product concentrations are attained. (auth)

MATHEMATICS

5581

Radiation Lab., Univ. of Calif., Berkeley

A SIMPLE ANALOGUE INSTRUMENT FOR SUMMING ANGLES IN THE ROOT LOCUS METHOD OF SOLVING ORDINARY EQUATIONS AND STABILITY PROBLEMS. Arnold H. Harris. July 10, 1953. 14p. (UCRL-2269)

The root-locus method of the treatment of stability problems in the field of servomechanisms is briefly sum-

marized. A simple mechanical instrument of the analog type (a summing device) containing no gear mechanisms, and designed to do most of the numerical work of the root-locus method, is also described. (auth)

5582

THE CAUSAL INTERPRETATION OF QUANTUM MECHANICS. Saul T. Epstein. *Phys. Rev.* **91**, 985(1953) Aug. 15.

In connection with the discussion given in a previous note, a classical Hamilton-Jacobi equation associated with the Schroedinger function in momentum space is derived. Certain "extra" terms in this equation are shown to be of quantum-mechanical origin. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

5583

Atomic Energy Research Establishment, Harwell, Berks (England)
THE CALORIMETRIC ESTIMATION OF ALPHA EMITTERS. W. R. E. Maton. Mar. 30, 1953. 17p. (AERE-C/R-1133)

A simple and accurate measurement of amounts of α emitters from 100 mc to some tens of curies is possible by determination of the heat emitted during the radioactive decay. A description of suitable calorimetric equipment is given. (auth)

5584

MEASUREMENT OF THE DEAD TIME OF A G-M COUNTER AND OF THE SECONDARY EMISSION OF THE CATHODE BY THE METHOD OF DELAYED COINCIDENCES. E. Picard and A. Rogozinski. *J. phys. radium* **14**, 445-50 (1953) July-Aug.-Sept. (In French)

The dead time of a G-M counter has been measured by the method of delayed coincidences. The impulses of the counter, which feed the coincidence circuit, were obtained directly and also after a known and variable delay. This method allows the study of the parasitic impulses caused by the impact of positive ions on the cathode of the counter. Some results relative to some counters operated under different conditions are given. (tr-auth)

5585

THE MEASUREMENT OF DISTORTION IN NUCLEAR EMULSIONS. Martin Caulton. *Rev. Sci. Instr.* **24**, 569-72 (1953) Aug.

A quantitative study of distortion in nuclear emulsions, based on a method of measuring and calculating distortion to known accuracy, has been made. The method has been applied to a study of variations in fixing, washing, and drying procedures. Distortion reduction up to $\frac{1}{2}$ was found to occur with the use of a concentrated Na_2SO_4 hypo solution. The reduction of vertical shrinkage and the use of thicker emulsions also appear to reduce distortion. The method of distortion measurement is accurate to better than 10% using sea-level cosmic-ray background tracks as a distortion indicator. (auth)

5586

NUCLEAR EMULSION TECHNIQUES FOR THE MEASUREMENT OF NEUTRON ENERGY SPECTRA. PART II. Louis Rosen. *Nucleonics* **11**, No. 8, 38-44(1953) Aug.

Applications of the nuclear emulsion for measurement of neutron intensity and energy spectra are presented. Plate exposure and analysis techniques are considered for low-energy, low-intensity neutron point sources. Specific applications are made to the T(d,n)He reaction and the inelastic interactions of 14-Mev neutrons with various elements. (For Part I of this paper see NSA 7-631.) (K.S.)

5587

A FAST COINCIDENCE-ANTICOINCIDENCE ANALYZER. Richard L. Garwin. *Rev. Sci. Instr.* **24**, 618-20(1953) Aug.

A modified Rossi circuit has been extended to a form in

which it allows the recording of as many as six coincidence and four anticoincidence pulses with a resolving time of 3×10^{-9} sec. All input pulses are negative and of any amplitude > 3 volts. A complete schematic is given of the circuit which has operated for six months without need of adjustment. (auth)

5588

RECENT DEVELOPMENTS IN THE PRODUCTION OF HALOGEN-QUENCHED GEIGER-MÜLLER COUNTING TUBES. L. B. Clark, Sr. *Rev. Sci. Instr.* **24**, 641-3(1953) Aug.

Geiger-Müller tubes have been constructed which use visibly transparent, nonmetallic, electrically conducting films as cathodes. These tubes have the following advantages: (1) a long plateau; (2) no photosensitivity; (3) an almost indefinite operating life; (4) immunity from damage arising from heavy discharges; (5) straightforward filing procedure devoid of any "passivizing" or saturating techniques; (6) good response to ionizing radiation throughout the length of the counter; (7) freedom from use of critical materials such as Cu or stainless steel No. 446 which require special cleaning and polishing procedures. (auth)

5589

A FAST NEUTRON COINCIDENCE SPECTROMETER. Paul R. Chagnon, Leon Madansky, and George E. Owen. *Rev. Sci. Instr.* **24**, 656-60(1953) Aug.

A fast-neutron coincidence spectrometer of high efficiency has been constructed, applicable to the approximate energy range of 1 to 20 Mev. Design considerations and the working model are discussed. To illustrate the operation of such an instrument, the line spectra of the γ rays from Co^{60} and of 3.3-Mev D-D neutrons are presented. Discrimination between γ rays and neutrons is obtained by utilizing the difference in the time of flight of the two particles. In conclusion possible improvements are suggested. (auth)

5590

ON ENERGY RESOLUTION WITH PROPORTIONAL COUNTERS. G. S. Hurst and R. H. Ritchie. *Rev. Sci. Instr.* **24**, 664-8(1953) Aug.

The shape of a proportional counter pulse due to an extended track of ionization is determined, before and after passing through a linear pulse amplifier, for various values of track extension and positive-ion collection time. It is found that the maximum height of the amplifier output-pulse is essentially independent of the length and orientation of the track in the counter, provided the time of collection of the outermost electrons is not longer than the amplifier time constant. (auth)

5591

LIQUID-SAMPLE GEIGER COUNTER. Leon Singer and W. D. Armstrong. *Nucleonics* **11**, No. 8, 55(1953) Aug.

Positioning and counting of liquid samples in a paraffined drinking cup placed directly on an inverted end-window counter are suggested. Sensitive counting from γ -ray and strong β -ray emitters is achieved. (K.S.)

5592

GENERAL CONSIDERATIONS REGARDING THE DOSIMETRY OF ROENTGEN AND GAMMA RADIATION. W. J. Oosterkamp. *Appl. Sci. Research B3*, 100-18(1953).

A distinction is made between the quantities "irradiation," which is measured in r, and "dose," which is measured in ergs/g. The methods by which both quantities can be measured are analyzed. The correlation between irradiation and dose is discussed: Irradiation is in nearly air-equivalent materials at moderate photon energies; in non air-equivalent tissue, the differences in mass absorption coefficient between this tissue and air should be taken into account; at discontinuities in the atomic composition the increased generation of secondary electrons in materials with higher

atomic number will also cause an increased ionization in neighboring tissues with lower atomic number; at photon energies above 1 Mev there is an increasing discrepancy between irradiation and dose at the same place. (auth)

5593

THE INDUCED LONGITUDINAL DEVELOPMENT OF NUCLEAR TRACKS IN PHOTOGRAPHIC EMULSIONS. J. P. Lonchamp. *J. phys. radium* **14**, 433-8(1953) July-Aug. - Sept. (In French)

It is shown that the relation of Freier relative to the "length of attenuation" of the tracks of heavy particles makes experimental results difficult to evaluate. In order to account quantitatively for the observed phenomena, a theory is proposed whereby the density of the δ rays are made to intervene the length of the trajectory. Examination of the fission tracks permits the determination of the role of the loss of specific energy. (tr-auth)

5594

THE n UNIT AND ENERGY ABSORPTION IN TISSUE. Harald H. Rossi. *Radiology* **61**, 93-6(1953) July.

Problems associated with dosimetry of fast neutrons are reviewed. Application of the n unit in the quantitation of neutron exposures of biological materials is discussed. The results of the calibrations of a number of Victoreen chambers at two neutron sources are presented. Factors affecting the response of different Victoreen chambers to neutron sources are discussed. (C.H.)

5595

AN IMPROVED ČERENKOV DETECTOR FOR COSMIC RAYS. John Winckler and Kinsey Anderson. *Rev. Sci. Instr.* **23**, 765-6(1952) Dec.

The performance of a Cherenkov detector, modified by the use of a C7157 RCA photomultiplier, is discussed. The photomultiplier cathode is coated on the inside of the cylindrical portion of the glass envelope and extends halfway around the circumference. The radiator is a lucite block cut concave on one end to fit the phototube and optically sealed to its surface. The photocathode thus constitutes the entire end of the radiator, and good collection efficiency and geometry were achieved for the Cherenkov radiation passing through the block. The pulse-height distribution obtained with the counter for Cherenkov radiation from high-energy sea-level cosmic rays is shown. (L.M.T.)

5596

THE SCINTILLATION PROCESS IN PLASTIC SOLID SOLUTIONS. Robert K. Swank and Warren L. Buck. *Phys. Rev.* **91**, 927-33(1953) Aug. 15.

The scintillation process has been studied in a number of systems involving a solid solution of an organic fluor in polystyrene or polyvinyltoluene. It has been determined that direct excitation of the solute by the ionizing radiation contributes a negligible amount to the observed scintillation for the concentrations studied. Fluorescence of the solvent followed by radiative transfer to the solute is a significant process, but the major fraction of the scintillation, in the more efficient systems, is transferred from the solvent to the solute by a nonradiative process. Comparison of optical data with data of pulse size vs. concentration points to dipole-dipole interaction as a means of energy transfer. Comparison of results with α and β particles shows that the same degree of quenching is present in the solvent for both types of excitation. (auth)

5597

FAST NEUTRON DOSIMETRY. G. S. Hurst and R. H. Ritchie. *Radiology* **60**, 464-8(1953) June.

Recent work on fast neutron dosimetry done by the Health Physics Division of the Oak Ridge National Laboratory is summarized. The use of count-rate dosimeters and the pulse-integration method are discussed in detail. (C.H.)

5598

TECHNIQUES AND APPLICATIONS OF NEUTRON DIFFRACTION. C. G. Shull. In "Modern Research Techniques in Physical Metallurgy." Cleveland, American Society for Metals, 1953. (p.154-69).

Comparisons are drawn between the new field of neutron diffraction and the older established fields of x-ray and electron diffraction. Techniques are described which have been developed for study in this field, and the usefulness of neutron-diffraction techniques is illustrated by citing a series of applications wherein additional, if not entirely unique, information is derived over that normally obtained by other procedures. (auth)

5599

RADIATION MEASUREMENTS BY CHEMICAL MEANS. W. Minder. *Helv. Phys. Acta* **26**, 407-10(1953). June 15. (In German)

A brief review is given of the use of irreversible chemical reactions in radiation measurement. 11 references. (J.S.R.)

MESONS

5600

Brookhaven National Lab.

EXAMPLES OF MULTIPLE PION PRODUCTION IN N-P COLLISIONS OBSERVED AT THE COSMOTRON. W. B. Fowler, R. P. Shutt, A. M. Thorndike, and W. L. Whittemore. [1953] 6p. (BNL-1508)

About 100 events attributed to π -meson production by neutrons in H have been photographed under conditions described in a previous communication (*Phys. Rev.* **90**, 1126(1953)). Neutrons produced in a C target by the 2.2-bev proton beam in the Cosmotron passed through appropriate collimators into a H-filled diffusion cloud chamber located in a field of 11,000 gauss. Two examples of creation of pairs of pions in the gas are shown, and data on these events are given. (auth)

5601

Brookhaven National Lab.

PRODUCTION OF V_1^0 PARTICLES BY NEGATIVE PIONS IN HYDROGEN. W. B. Fowler, R. P. Shutt, A. M. Thorndike, and W. L. Whittemore. [1953] 6p. (BNL-1526)

An analysis is given of a cloud-chamber photograph which is believed to represent the production of a V_1^0 particle by a π^- interaction with a proton. The event was recorded in an H-filled chamber at 18 atm. with a field of 11,000 gauss and an incident pion energy of 1.5 bev. (K.S)

5602

Radiation Lab., Univ. of Calif., Berkeley

TOTAL POSITIVE PION CROSS SECTIONS IN COMPLEX NUCLEI (thesis). Donald Harvey Stork. July 27, 1953. 69p. (UCRL-2288)

The attenuation cross sections and cross sections for scattering into a ring counter were measured in a well defined geometry for positive pions of energies 33, 46, and 68 Mev. The targets were Be, C, Al, and Cu. After correction for muon flux, accidentals, pion-muon decay, and multiple-coulomb scattering, the results were analyzed in terms of a complex square well as treated by the optical model. The coulomb scattering and interference were calculated in the Born approximation. A strong energy dependence was found for the interaction mean free path in nuclear matter. The energy dependence for the mean free path, λ_a , was suggested to be given by $\lambda_a = [2b(\ln \epsilon)^4/\gamma^2]^{-1}$, and b was found to be $0.21_{-0.03}^{+0.04}$. This was verified by a comparison of the optical-model results with other published pion-nucleus interaction data. Good agreement was found with the least squares value for b given as 0.26 ± 0.02 . The interaction mean free path thus derived was compared to

that calculated by means of the multiple scattering theory and the pion-scattering amplitudes for the case of free nucleons. A rough agreement was found using the pion-scattering phase shifts of Anderson, et al., and of Bodansky, et al. (auth)

5603

RADIATION CORRECTIONS IN THE DECOMPOSITION OF μ -MESONS. E. M. Lipmanov. *Doklady Akad. Nauk S.S.S.R.* 90, 999-1001(1953) June 21. (In Russian)

Complete radiation corrections to the electron spectrum of decomposition of μ mesons were derived. In the range of the most probable energy, the correction is of the order of 0.5% for all types of interaction. (J.S.R.)

5604

NEUTRAL V-PARTICLES. H. den Hartog. *Ned. Tijdschr. Natuurk.* 19, 105-14(1953) May. (In Dutch)

A review is given of the production and disintegration of V particles. Theories about their nature are discussed. 16 references. (J.S.R.)

5605

THE MEAN LIFE OF NEGATIVE μ MESONS STOPPED IN IRON. A. H. Benade. *Phys. Rev.* 91, 971-2(1953) Aug. 15.

The mean life of negative cosmic-ray μ mesons stopping in an Fe absorber has been found experimentally to be $0.21 \pm 0.06 \mu\text{sec}$. The upper limit to the mean number of neutrons produced is very roughly one per meson captured by an Fe nucleus. (auth)

5606

THE DECAY OF THE τ -MESON. R. H. Dalitz. *Proc. Phys. Soc. (London)* A66, 710-13(1953) Aug.

The applicability of the hypothesis of charge independence is discussed for the τ meson. One consequence of this hypothesis is that the frequency of charged τ meson decay leading to a single-charged π meson must exceed $1/4$ that of the established decay into three charged π mesons. (auth)

5607

DEPENDENCE OF PRIMARY AND COMPLETE IONIZATION OF μ -MESONS ON ENERGY. G. P. Eliseev, V. K. Kosmach-evskii, and V. A. Lyubimov. *Doklady Akad. Nauk S.S.S.R.* 90, 995-8(1953) June 21. (In Russian)

The experimentally determined dependence of primary ionization and complete ionization of μ -mesons on energy is graphed. The agreement with the theoretical is good. The probable error of the experiments is discussed. (J.S.R.)

METEOROLOGY

5608

Brookhaven National Lab.

THE USE OF AVERAGES IN AIR POLLUTION METEOR-
OLOGY. Irving A. Singer and Maynard E. Smith. May 15, 1953. 13p. (BNL-1513)

The literature on the meteorology of stack dispersion contains references to "average" conditions, suggesting that such conditions are common and that dispersion calculations based on them will be representative. Studies made at Brookhaven National Lab. show that the conditions usually described as "average" are in fact uncommon at that location and probably in most locations in the United States. The variability of wind gustiness, an index of dispersion conditions, is described and related to other meteorological parameters to illustrate the desirability of determining the most probable conditions, rather than the average. A study of dispersion from an individual stack should reveal the conditions under which the effluent will have undesirable effects and describe the seasonal and diurnal frequencies of those conditions. Hypothetical examples are used to show how different stack and effluent characteristics may result in wholly different pollution problems under identical meteorological conditions. (auth)

MOLECULAR PROPERTIES

5609

Delaware Univ.

ELECTRIC FIELD GRADIENTS OF ATOMIC p-ELECTRONS. Richard G. Barnes and William V. Smith. Aug. 12, 1953. 20p. (NP-4715; Technical Report 1)

Calculations from optical-spectra data of the electrostatic-field gradient existing at the position of the nucleus in atoms depend on the effective atomic number Z_1 . The present article presents a survey of Z_1 values obtained for various elements in varying degrees of ionization. It may be concluded from this survey that the relation $Z_1 = Z - n$ is a good approximation for calculations dealing with p-electrons. On the basis of this relation the average $\langle 1/r^2 \rangle$ has been evaluated for low-lying states of interest in chemical bonding for atoms having p valence electrons. The results are presented in a graphical form from which the values for the more complicated cases of N, P, As, and Sb are obtained by interpolation. Atomic-field gradients obtained in this article are compared with previous estimates in a number of cases of interest. (auth)

NUCLEAR PHYSICS

5610

REPULSIVE CORE AND CHARGE INDEPENDENCE. E. E. Salpeter. *Phys. Rev.* 91, 994-6(1953) Aug. 15.

In an earlier paper Schwinger derived expressions for the effective strengths of the n-p and p-p interactions in the singlet S state. He showed their difference is small and can be accounted for by magnetic forces if a long-tailed potential (Yukawa) is assumed but not for a short-tailed potential. In this paper an equivalent analysis is carried out for nuclear potentials which have a repulsive core. It is shown that for core radii of more than about 0.3×10^{-13} cm the effect of the magnetic interaction is decreased and the difference between the n-p and p-p interactions is increased. Numerical values of the discrepancy are given for different core radii. (auth)

NUCLEAR PROPERTIES

5611

Brookhaven National Lab.

METASTABLE STATES OF Ge^{73} . Joan P. Welker, A. W. Schardt, G. Friedlander, and J. J. Howland, Jr. [1953] 26p. (BNL-1509)

The decay of As^{73} to Ge^{73} has been investigated with scintillation counters. The K-capture is followed by a 53.9-keV γ ray which in turn is followed by a 13.5-keV transition to the ground state. The total conversion coefficient of the 53.9-keV γ is 4.7 and the lifetime is between 900 μsec and 10 sec. The half-life of the 13.5-keV transition is 4.6 μsec . The available evidence points to the 53.9-keV transition being M2 and the 13.5-keV transition E2 with a possible small admixture of M1. Spin and parity assignments are discussed. (auth)

5612

Brookhaven National Lab.

DISINTEGRATION SCHEME OF Br^{80} (18 min). Gertrude Scharff-Goldhaber and Michael McKeown. 1953. 10p. (BNL-1522)

The 18-min isomer Br^{80} is shown to emit γ rays of 620-keV energy which follow a low intensity ($9 \pm 2\%$) β -ray branch. Beta-gamma coincidences are observed, indicating that the γ transition takes place in Kr^{80} . No γ -ray transition was found to follow the positron or K-capture branch. The intensity observed is compatible with a spin and parity assignment 1^+ for the ground state of Br^{80} , while the 620-keV state in Kr^{80} is probably 2^+ . The γ -ray energy ob-

served fits well into the pattern for the energy of the first excited state of even-even nuclei. (auth)

5613

Brookhaven National Lab.

THERMAL ABSORPTION CROSS SECTIONS OF BORON AND GOLD. R. S. Carter, H. Palevsky, V. W. Myers, and D. J. Hughes. [1953] 23p. (BNL-1523)

The cross sections of B and Au, which are widely used as standards for slow-neutron measurements, have been determined as functions of wavelength. Total cross sections were measured in the wavelength range 1.5 to 10 Å with the Brookhaven slow chopper, the long wavelengths being used to minimize the effects of scattering. The absorption cross section of B of "normal" isotopic constitution is 749 ± 4 barns at 2200 m/sec. The variation of cross section with B source is expected to be only about 1%. The measurement of the Au cross section is complicated by the deviation from $1/v$ resulting from a nearby resonance and by grain orientation effects in the scattering. The 2200 m/sec value, resulting from measurements at long wavelength together with a small correction for the 4.9 eV resonance, is 98.7 ± 0.6 barns. (auth)

5614

Brookhaven National Lab.

SLOW NEUTRON RESONANCES IN HOLMIUM, THULIUM, AND LUTETIUM. H. L. Foote, Jr., H. H. Landon, and V. L. Sailor. [1953] 18p. (BNL-1529)

The total cross sections of Ho, Tm, and Lu have been measured over the neutron-energy range from 0.1 to ~ 30 eV. Resonances were found in Ho¹⁶⁵ at 3.96, 12.8, 19, 22, and 39 eV; and, in Tm¹⁶⁹ at 3.92, 14.8, and 17.6 eV. Of the many resonances found in Lu, the following tentative isotopic assignments have been made: Lu¹⁷⁵ resonances at 5.30, 11.4, 14.4, 20.6, 24, and 31 eV; and, Lu¹⁷⁶ resonances at 0.142, 1.57, 2.62, and 4.80. It is probable that many additional resonances are present at higher energies in Lu¹⁷⁶ but were not observed. The average spacing between resonances in Ho¹⁶⁵, Tm¹⁶⁹, and Lu¹⁷⁵ (odd-even isotopes) is estimated to be of the same order of magnitude; i.e., respectively 10, 10, and 6 eV; while the spacing in Lu¹⁷⁶ (odd-odd) appears to be much smaller, of the order of 1 to 2 eV. Parameters for several of the resonances have been obtained. (auth)

5615

ON THE THEORY OF SPIN. V. L. Ginzburg and I. E. Tamm. Translated by G. Belkov from *Zhur. Eksptl' i Teoret. Fiz.* 17, 227-37(1947). 23p. (AEC-tr-1548; TT-305)

A theory of spin is developed by constructing relativistic equations for the wave function which depend not only on the coordinates of the particle but also on other four-dimensional tensors (spinors). This method, which discloses a large number of possibilities, leads to new quantities which transform according to an infinite dimensional, unitary representation of the Lorentz group and do not become ordinary spinors. (auth)

5616

CONTRIBUTION TO THE EXPERIMENTAL STUDY OF NUCLEAR ISOMERISM; APPLICATION OF THE METHOD OF DELAYED COINCIDENCES TO THE RESEARCH AND STUDY OF METASTABLE STATES OF SHORT PERIOD. René Ballini. *Ann. phys.* 8, 441-88(1953) May-June. (In French)

A time selector and an amplitude selector have been studied as methods of delayed coincidences. The first method was used to study the operation of a G-M counter and to measure the period of Ta¹⁸¹ under various experimental conditions. The value obtained was 17.2 ± 0.2 μ sec. (J.S.R.)

5617

Q-VALUE OF THE (n, α) REACTION IN CHLORINE³⁵. P. Huber and H. Adler. *Helv. Phys. Acta* 26, 427-8(1953). June 15. (In German)

The Q-value of the (n, α) reaction in Cl³⁵ was determined to be 0.97 ± 0.16 MeV. (J.S.R.)

5618

THE DETERMINATION OF THE 0 AND $\hbar/2$ SPIN OF NUCLEI FROM THE MICROWAVE SPECTRA OF MOLECULES. A. M. Prokhorov and N. G. Basov. *Doklady Akad. Nauk S.S.S.R.* 90, 1003-4(1953) June 21. (In Russian)

The number of the lines in the microwave spectrum and their relative distribution and intensity determine the magnitude of the spin of the nucleus. The spin was determined from the fact that, if one or more nuclei entering the body of a molecule possess quadrupole moment, the rotational terms of the molecule break down and there is increase of hyperfine structure and interaction of the nuclear quadrupole moment with the electron field of the molecule. (J.S.R.)

5619

THE PILE NEUTRON ABSORPTION CROSS SECTIONS OF BISMUTH. D. J. Littler and E. E. Lockett. *Proc. Phys. Soc. (London)* A66, 700-4(1953) Aug.

The pile-neutron absorption cross section of Bi has been measured as 30.8 ± 2.2 mb. Also the activation cross section of Bi for the production of Po²¹⁰ has been measured as 20.5 ± 1.1 mb. The difference between these two values, namely 10.3 ± 2.5 mb, is claimed to be the activation cross section for the production of a long-lived α -particle-emitting state of Bi²¹⁰. (auth)

NUCLEAR REACTORS

5620

A METHOD OF CALCULATING CRITICAL SIZE IN MULTI-GROUP NEUTRON TRANSPORT THEORY FOR SOME SIMPLE SYSTEMS. E. R. Woodcock. *Proc. Phys. Soc. (London)* A66, 705-9(1953) Aug.

A simple method is developed for obtaining a good approximation to the critical size of some simple nuclear reactors when neutrons of all relevant energies are allowed for by dividing them into a number of energy groups. The method is applicable to any number of energy groups. (auth)

NUCLEAR TRANSFORMATION

5621

Radiation Lab., Univ. of Calif., Berkeley
ANALYSIS OF SECONDARY PARTICLES RESULTING FROM HIGH-ENERGY NUCLEAR BOMBARDMENT (thesis). Robert W. Deutsch. July 1, 1953. 76p. (UCRL-2258)

Thin foils of Be, Al, Ni, Ag, Au, and U have been bombarded by an internal beam of 375-MeV alphas, 332-MeV protons, and 187-MeV deuterons. Secondary particles emerging from the disintegration of the nucleus at 0° to the incident-beam direction are detected in nuclear emulsions located beneath the median plane of the 184-in. cyclotron. There are three specific positions for these emulsions corresponding to energies of the secondary protons and of alpha particles of approximately 6, 10, and 20 MeV. The angular distribution of secondary particles has also been measured for 240-MeV α bombardment of Be, Al, Ni and Ag. Here, secondary particles emitted at 0, 45, and 135° are detected in nuclear emulsions at positions for which the secondary proton and α energy is approximately 6 MeV. A secondary particle is identified by measurement of its radius of curvature upon entering the emulsion and its range and specific ionization in the emulsion. A considerable yield of H and He isotopes as well as of particles of higher atomic number is found. The relative yields of the secondary protons and α particles for each element and for each bom-

bardment are shown as a function of energy. The results are found to be consistent with the predictions of an evaporation model. (auth)

5622

Radiation Lab., Univ. of Calif., Berkeley
SPALLATION AND FISSION OF SILVER (thesis). Per Kristen Kofstad. June 30, 1953. 57p. (UCRL-2265)

The spallation and fission products of elemental Ag with 340-Mev protons have been determined. The cross-section measurements include some 60 nuclides from Be through Cd. The distribution of the yields is in agreement with Serber's theories regarding high-energy nuclear reactions. It indicates that heavy nuclear fragments are emitted in high-energy nuclear reactions. (auth)

5623

Radiation Lab., Univ. of Calif., Berkeley
BROMINE ISOTOPES PRODUCED BY CARBON ION BOMBARDMENT OF COPPER. Jack M. Hollander. July 10, 1953. 6p. (UCRL-2273)

Decay curves of Br fractions separated from Cu foils bombarded in the internal C-ion beam of the 60-in. cyclotron showed two activities of half lives 95 ± 3 and 36 ± 2 min, the first of which was assigned to Br^{76} produced by the $\text{Cu}^{65}(\text{C}^{12}, 2n)$ reaction. In an attempt to assign the 36-min activity, C-ion bombardments were made on isotopically enriched CuO targets of 99.7 and 1.84% Cu^{63} , respectively. In spite of a more than fiftyfold enrichment of Cu^{63} in the 99.7% sample as compared with the 1.84% sample, the ratio of the 36/95 min activities was only slightly greater, and the absolute yield of the 36-min activity was lower by a factor of ~ 50 in the 99.7% than in the 1.84% sample. This indicated that the 36-min activity was made in Cu^{63} by a reaction of very low cross section, and it was tentatively assigned to Br^{74} by the $\text{Cu}^{63}(\text{C}^{12}, n)$ reaction. (L.M.T.)

5624

Radiation Lab., Univ. of Calif., Berkeley
THE ANGULAR DISTRIBUTION AND YIELD OF THE PROCESS $p + d \rightarrow t + \pi^+$ (thesis). Wilson J. Frank. May 18, 1953. 39p. (UCRL-2292)

The angular distribution of the process $p + d \rightarrow t + \pi^+$ has been determined. The process was identified at one angle by a comparison of measured and predicted angles of correlation, ranges of the particles, and time of flight of the triton. The same method was used at the other angles, with the apparatus set for the predicted correlated angles, minimum ranges, and triton time of flight; however, no further tests were made because of the low counting rates in the experiment. The results, corrected for pion absorption and decay in flight and pion and triton multiple scattering, are given. From the angular distribution the total yield of the process is estimated to be 15 μb . (auth)

5625

PHOTODISINTEGRATION OF THE DEUTERON AT 20 MEV. J. Halpern and E. V. Weinstock. *Phys. Rev.* **91**, 934-9 (1953) Aug. 15.

Counter techniques have been applied to a study of the proton angular distribution in the photodisintegration of the deuteron induced by bremsstrahlung photons from a betatron in the energy interval 18 to 22 Mev. The measured distribution is given by $A + \sin^2\theta (1 + 2\beta \cos\theta)$, with $A = 0.132 \pm 0.041$ and $\beta \approx 0.1$. The total cross section is also measured. (auth)

5626

THE ANGULAR DISTRIBUTION OF 12-MEV GAMMA RAYS FROM PROTON BOMBARDMENT OF B^{11} . G. L. Jenkins, L. W. Cochran, B. D. Kern, and T. M. Hahn. *Phys. Rev.* **91**, 915-17 (1953) Aug. 15.

To investigate possible interference between the three excited states in C^{12} arising from proton bombardment of

B^{11} at proton energies of 163, 680, and 1388 kev, the angular distribution of 12-Mev γ rays from proton bombardment of thick natural B targets has been investigated in the energy region between 200 and 1100 kev. The 12-Mev γ rays were resolved with a scintillation spectrometer. The angular distribution with respect to the proton beam was found to be of the form $Y(\theta) = 1 + A \cos\theta + B \cos^2\theta$, with A vanishing at 200 kev, reaching a value of 0.13 between 300 and 350 kev, and remaining approximately constant above this energy, up to 1100 kev. The value of B is 0.22 at 200 kev, decreases to 0.09 at 500 kev, and remains approximately constant above this energy up to 1100 kev. (auth)

5627

THE BREAKUP ENERGY OF Be^8 . Samuel K. Allison. *Phys. Rev.* **91**, 882 (1953) Aug. 15.

Re-examination of the energy spectrum of the scattered protons and the disintegration particles from Be under bombardment with protons of approximately 400-kev energy has shown that a particle group previously thought to be the breakup α particles from Be^8 was in fact a low-energy group of scattered protons from the impact and breakup of unfocused H_2^+ on the target. A value of the breakup energy of Be^8 (77.5 kev) based on this mistaken identification is withdrawn. (auth)

5628

EXCITATION FUNCTIONS FOR PROTON-INDUCED REACTIONS WITH COPPER. J. W. Meadows. *Phys. Rev.* **91**, 885-9 (1953) Aug. 15.

Proton bombardment at energies up to 100 Mev have been carried out in the Harvard Univ. cyclotron using targets of Cu^{63}O and Cu^{65}O . Absolute cross sections of the (p, n) , $(p, 2n)$, (p, pn) , and $(p, p2n)$ reactions of Cu^{63} and the $(p, 3n)$, $(p, 4n)$, (p, pn) , $(p, p3n)$, and $(p, p4n)$ reactions of Cu^{65} have been determined using the $\text{C}^{12}(p, pn)\text{C}^{11}$ and $\text{Al}^{27}(p, 3pn)\text{Na}^{24}$ reactions to monitor the proton beam. An estimate of the ratio of level densities for odd-odd and even-even nuclei is made. (auth)

5629

PHOTODISINTEGRATION PROCESSES IN LIGHT EVEN-EVEN NUCLEI YIELDING ALPHA-PARTICLES. D. L. Livesey and C. L. Smith. *Proc. Phys. Soc. (London)* **A66**, 689-99 (1953) Aug.

The photodisintegration processes splitting the nuclei C^{12} and O^{16} completely into α particles have been studied in some detail by the photographic-plate method. It is found that, for energies below about 25 Mev, resonances occur in the excitation functions, indicating that a compound-nucleus interpretation may be valid. These results, and also certain data of Green and Gibson concerning the inelastic scattering of neutrons in C, are related to excited states of the nuclei C^{12} and Be^8 as intermediate stages in the various processes. Levels in C^{12} at 9.6 and 11.3 ± 0.3 Mev occur, and these yield first an α particle and Be^8 in the ground state. A third level in C^{12} near 12 Mev is found to yield Be^8 in the broad 3-Mev excited state. Other levels in Be^8 at 4.1 and 17 Mev, disintegrating into two α particles, are found as intermediate stages in these reactions. (auth)

PARTICLE ACCELERATORS

5630

STABILITY OF ORBITS IN A STRONG-FOCUSING SYNCHROTRON. Stig Lundquist. *Phys. Rev.* **91**, 981-3 (1953) Aug. 15.

The influence of gaps for injection, acceleration, etc., on the stability of orbits in a strong-focusing synchrotron is examined and found not to be negligible. The calculation also gives some information about the resonances resulting from irregularities. (auth)

5631

THE DESIGN AND OPERATION OF A 4.5 MICROTRON. C. Henderson, F. F. Heymann, and R. E. Jennings. *Proc. Phys. Soc. (London)* B66, 654-64(1953) Aug. (cf. NSA 7-1813).

The design and construction of a 4.5-Mev microtron is described. The machine operates at a wavelength of 10 cm at a magnetic field of ~ 1000 gauss. The diameter of the final orbit is approximately 30 cm. A circulating current of about $0.2 \mu\text{a}$ mean has been observed at a duty cycle of 4×10^{-4} , with a 500 kw peak microwave source. A simple and efficient method of beam extraction has been developed. This has enabled a beam of semi-angles 1.5° in the horizontal plane and 0.3° in the vertical plane to be brought into the laboratory. It is concluded that with sufficient r-f power, the output of the microtron should compare favorably with that obtainable from linear accelerators. (auth)

RADIATION ABSORPTION AND SCATTERING

5632

Brookhaven National Lab.

A THEOREM CONCERNING ANGULAR CORRELATIONS. J. Weneser and D. R. Hamilton. [1953] 8p. (BNL-1527)

It is shown that in a cascade of any number of basic transitions between states of monotonically increasing or decreasing angular momenta the angular correlation between any two of the radiations is independent of the spins, the number and character of the intermediate steps, or the order in which the radiations occur. (auth)

5633

Radiation Lab., Univ. of Calif., Berkeley

ABSOLUTE CROSS SECTIONS OF THE REACTION $p + p \rightarrow \pi^+ + d$ (thesis). Frank Stevens Crawford, Jr. Apr. 23, 1953. 71p. (UCRL-2187)

Absolute differential cross sections for the reaction $p + p \rightarrow \pi^+ + d$ were obtained by detecting meson-deuteron coincidences produced by passing the 340-Mev external proton beam of the Berkeley synchrocyclotron through a liquid H_2 target. The results obtained are as follows:

Av. proton lab. energy Mev	pion c.m. energy Mev	$\frac{d\sigma}{d\Omega \text{ c.m.}} \times 10^{30}$ $\text{cm}^2 \text{ster}^{-1}$	total cross section \times 10^{30}cm^2 ster^{-1}
338	21.5	$34[(0.29 \pm 0.08) + \cos^2\theta]$	269 ± 26
332	19.0	$30[(0.32 \pm 0.05) + \cos^2\theta]$	245 ± 13
324	15.5	$23[(0.28 \pm 0.07) + \cos^2\theta]$	178 ± 16

(auth)

5634

Radiation Lab., Univ. of Calif., Berkeley

ATTENUATION OF 33 MEV POSITIVE PIONS IN HYDROGEN (thesis). Stanley Lee Leonard. May 1953. 38p. (UCRL-2211)

The attenuation of 33-Mev positive pions in H has been studied by scintillation-counter techniques. A beam of positive pions was produced by bombarding a polyethylene target in the scattered-deflected proton beam of the Berkeley synchrocyclotron. Pions of the desired momentum were selected by a magnetic field, collimated, and allowed to pass down a scintillation-counter telescope. After passing through a thin anthracene defining counter and through two stilbene counters, the pions entered a liquid H target. Directly behind the target was a large liquid scintillation counter which subtended an angle of 70° at the center of the H. An oscilloscope sweep was triggered by a threefold coincidence from the first three counters. Pulses from the stilbene crystals and from the rear counter were displayed on the sweep, separated in time by delay lines. The oscilloscope screen was photographed on continuously

moving film. After the film was developed, it was examined to determine how many pions, identified by the momentum selection and by the height of the pulses from the stilbene crystals, failed to produce a pulse in the rear counter. From this number the total cross section for 33-Mev positive pions in hydrogen has been calculated. This result has been corrected for attenuation in the second stilbene counter and in the walls of the hydrogen target, and for the muon contamination of the pion beam. In addition, the result has been corrected for spurious attenuation events caused by pion decay after the first stilbene counter. The corrected cross section is $6.4 \pm 2.0 \text{ mb}$. (auth)

5635

Radiation Lab., Univ. of Calif., Berkeley

THE SPECTRA OF PARTICLES EMITTED FROM HEAVY ELEMENTS BOMBARDED BY 31-MEV PROTONS (thesis). George J. Igo. June 1953. 57p. (UCRL-2242)

The energy distributions of inelastically scattered particles emitted by thin foils of Sn, Ta, Au, and Pb when bombarded by 30.7-Mev protons have been measured at five scattering angles. The spectra of inelastically scattered charged particles from the four elements at each deflection angle are quite similar in shape and in magnitude, and the peaks of the distributions fall at higher energies at small scattering angles. The angular distributions are strongly peaked forward. These results are in qualitative agreement with a nucleon-nucleon type process occurring on the rim of the nucleus. The inelastically scattered particles are mainly protons. The differential cross section for elastic scattering is in agreement with an opaque-sphere model for the nucleus. The distribution of energy losses of 30.7-Mev protons passing through a thin absorber has a full width at half-maximum of 50% and a high-energy tail, in agreement with the theory of Landau and Symon. A method has been developed to narrow the full width of the distribution to 35% and to eliminate the high-energy tail. (auth)

5636

Radiation Lab., Univ. of Calif., Berkeley

ELASTIC SCATTERING OF 340-MEV PROTONS BY DEUTERONS (thesis). D. D. Clark. June 25, 1953. 70p. (UCRL-2255)

The differential cross section for the elastic scattering of 340-Mev protons by deuterons has been measured at 7 angles from 40 to 150° in the center-of-mass system. A coincidence counting system using scintillation counters detected both product particles, the elastic effect being separated from the inelastic through identification of the scattered deuterons by photographically recorded pulse heights produced in a counter telescope. The resulting cross section is peaked strongly at small angles and exhibits a rise in the large-angle (pick-up) region. Comparison is made with an approximate theoretical curve calculated by a method of Chew. (auth)

5637

GAMMA-RAY ATTENUATION. PART I. BASIC PROCESSES. U. Fano. *Nucleonics* 11, No. 8, 8-12(1953) Aug.

The basic interaction processes of photons, in the energy range 0.1 to 10 Mev, are reviewed. The effects of these interactions upon the photon are discussed, together with process probabilities, secondary energy-dissipation effects, energy transport, and absorption coefficients for several materials. (K.S.)

5638

MESON-DEUTERON REACTION AND NUCLEON ISOBARS. Sadahiko Matsuyama and Hironari Miyazawa. *Progr. Theoret. Phys. (Japan)* 9, 492-500(1953) May.

The mesodisintegration of deuterons and the scattering of π mesons by deuterons are discussed, nucleon isobars being

introduced rather phenomenologically. Agreement with experiment is satisfactory in the case of mesodisintegration, and the deviations from impulse approximation in the case of the scattering are in the right direction. (auth)

5639

THE ELASTIC SCATTERING OF PROTONS BY LITHIUM. W. D. Warters, W. A. Fowler, and C. C. Lauritsen. *Phys. Rev.* **91**, 917-21(1953) Aug. 15.

The cross section for the reaction $\text{Li}^7(p,p)$ has been measured over the proton energy range 360 to 1400 kev. Measurements were made at scattering angles of 50, 70, 89.2, 110, 130, 143.4, and 160° in the c.m. system. Anomalous scattering was observed near 441.5 kev, the resonance energy for the reaction $\text{Li}^7(p,\gamma)$, and near 1030 kev, the resonance energy for the reaction $\text{Li}^7(p,p')$. Analysis of the results at 441.5 kev indicates a state in Be^8 with $J = 1$, even parity, formed by p-wave protons. The relative stopping cross section for protons in lithium was also measured from 200 to 1300 kev. (auth)

5640

PRODUCTION OF CHARACTERISTIC X-RAYS BY PROTONS OF 1.7- TO 3-MEV ENERGY. H. W. Lewis, B. E. Simmons, and E. Merzbacher. *Phys. Rev.* **91**, 943-6(1953) Aug. 15.

Characteristic x rays produced when protons of 1.7- to 3-Mev energy are stopped in thick targets of Mo, Ag, Ta, Au, and Pb have been studied using a NaI scintillator. K and L radiation for the three heavy elements produced well-separated differential pulse-height peaks, while only the K radiation was detectable for Mo and Ag. Cross sections for K ionization have been calculated, with corrections for the Auger effect, and compared with the theory. Ratios of experimental to theoretical cross sections vary from one to four, with good agreement for the light elements and low proton energies. The measured cross sections at 2.4-Mev proton energy are 11, 3.0, 0.036, 0.016, and 0.010 b for Mo, Ag, Ta, Au, and Pb, respectively. (auth)

5641

NUCLEON POLARIZATION IN PION PROTON SCATTERING. E. Fermi. *Phys. Rev.* **91**, 947-8(1953) Aug. 15.

The polarization of the recoiling nucleons after the scattering of a pion by a nucleon is calculated. It is found that the recoiling nucleons are polarized in a direction perpendicular to the scattering plane and that the intensity ratio for spin parallel or antiparallel to this direction in several cases is quite large. Simple formulas are given for computing the polarization as a function of the scattering angle in terms of the phase shifts. (auth)

5642

THE ELASTIC SCATTERING OF NEUTRONS BY TRITONS AND OF PROTONS BY He^3 . P. Swan. *Proc. Phys. Soc. (London)* **A66**, 740-52(1953) Aug.

The theory of the elastic collisions of neutrons with tritons which was given in an earlier paper by the author and applied to an energy of 14 Mev is here extended to cover a number of neutron energies between 2.5 and 14 Mev. The scattering phases are evaluated by means of the variational methods of Hulthén and Kohn. The corresponding angular distributions for proton- He^3 scattering are obtained by treating the coulomb field as a perturbation on the neutron-triton scattering, as both cases have the same symmetry properties. (auth)

5643

A SEARCH FOR POLARIZATION OF HIGH ENERGY NEUTRONS. J. M. Dickson and D. C. Salter. *Proc. Phys. Soc. (London)* **A66**, 721-8(1953) Aug.

An attempt has been made to detect polarization effects in n-p scattering. A Be target bombarded by protons was used to produce polarized neutrons, and a search was made

for asymmetry when these neutrons were scattered by H. A polarization effect of $-1.6 \pm 2.1\%$ was observed, which is to be compared with a predicted effect of +6%. It is concluded that either little polarization is produced in n-p scattering or the polarization effect is smeared out in some way when the elementary collision takes place inside a Be nucleus. (auth)

RADIATION EFFECTS

5644

Massachusetts Inst. of Tech.

RADIATION DAMAGE EFFECTS ON ORDER-DISORDER IN NICKEL-MANGANESE ALLOYS. Lewis R. Aronin. July 22, 1953. 24p. (AECU-2634)

Effects of fast-neutron irradiation in a nuclear reactor on order-disorder in a series of Mn-Ni alloys ranging from 16.5 to 31.9 at.% Mn have been studied by resistivity and magnetic-induction measurements. Attainment of an irradiated state differing from either cold work or thermal disordering is suggested by comparison of exposure results on initially cold-work disordered and initially thermally disordered Ni_3Mn . In a region from 16.5 to approximately 22% Mn, thermally disordered alloys are markedly affected by irradiation. These effects also appear to be superposed on the disordering produced by irradiation of initially ordered alloys. From theoretical exponential dependence on the period of irradiation, fast-neutron disordering of Ni_3Mn is determined by relating the Bragg and Williams order parameter quadratically with resistivity and linearly with magnetic induction. This leads to an estimate of 5000 for the ratio of the number of atomic replacements to primary collisions with neutrons of energy in excess of 0.5 Mev. (auth)

5645

Purdue Univ.

RADIATION DAMAGE RESEARCH; SECOND QUARTERLY REPORT, OCTOBER 1 TO DECEMBER 31, 1952. [Mar. 31, 1953] 92p. (COO-104; Quarterly Report 2)

Several approaches to the study of radiation damage in crystals are reported. The sensitivity of thermal conductivity to lattice imperfection is initially studied by conductivity experiments with single Ge crystals in the temperature range 56 to 87°K . Details on the design and construction of an apparatus for testing samples at low temperatures are given. The electrical conductivity of Ge was measured during bombardment by 4.2-Mev electrons at room temperature. Sharp decreases in conductivity as a function of flux were noted, in addition to a distinct tendency toward recovery when the beam was turned off. Indentation tests on the hardness of single Mo crystals showed that hardness number depends on the orientation of the grain with respect to the axis of the indenter. Further results are presented on the effect of deuteron irradiation on the hardness of these crystals. The report is concluded by an extensive theoretical and experimental treatment of the x-radiation damage in single crystals. Previous theory of x radiation scattered by an ideal lattice is modified to take into account the random displacement of the lattice points. X-ray-crystallographic studies were conducted to determine the elastic constants of Ge and Si by measurement of the diffuse scattering intensity. (K.S.)

5646

EFFECT OF GAMMA RADIATION ON CERTAIN RUBBERS AND PLASTICS. John W. Ryan. *Nucleonics* **11**, No. 8, 13-15(1953) Aug.

Gamma-ray irradiation effects upon the mechanical properties of polyethylene, nylon, Koroseal, Buna-N, neoprene, natural rubber, and Thiokol are studied. In general,

it is shown that the deterioration process results in a decrease in plastic flow and an increase in the elastic modulus. (K.S.)

5647

RADIATION-RESISTANT FUSED SILICA. A. John Gale and F. A. Bickford. *Nucleonics* 11, No. 8, 48(1953) Aug.

Specimens of various fused silica were bombarded by 2-Mev electrons, incident at the rate of $0.1 \mu\text{a}/\text{cm}^2$. Corning fused silica displayed good resistance to break down and discoloration. Plate glasses containing Ce and rutile and fused Al_2O_3 also demonstrated good resistance to radiation damage. (K.S.)

5648

IRRADIATION-INDUCED PHOTOCONDUCTIVITY IN MAGNESIUM OXIDE. Harold R. Day. *Phys. Rev.* 91, 822-7 (1953) Aug. 15.

Crystals of MgO have been colored by irradiation with ultraviolet light and neutrons. The spectral distribution of optical absorption has the form of a gradually increasing tail extending from the visible region to the far ultraviolet upon which are superimposed several absorption bands. Photoconductivity in single crystals of MgO was measured by a d-c method using a vibrating reed electrometer. The spectral distribution of photoconductivity is characterized by a gradually rising tail with superimposed peaks at 2.1, 3.7, and 4.8 ev, corresponding to known optical absorption bands. A photoconductivity band was found at 1.2 ev which has not been detected by optical absorption measurements. Irradiation of the crystals by ultraviolet light causes an enhancement of the photoconductivity subsequently measured in the 1.2- and 2.1-ev bands. The enhancement effect reaches a saturation level which is independent of the intensity of the ultraviolet light and which is a measure of the density of imperfections in the crystal lattice. The ultraviolet activated region can be displaced by an electric field in such a direction as to indicate that the charge carriers are holes in the valence band. Neutron irradiation of the crystals gives rise to a thermally unstable enhancement of photoconductivity throughout the spectrum and also causes an increase in the level of saturation of the ultraviolet activation. The latter increase is stable at room temperature and indicates that the neutron irradiation produces new lattice defects. This effect saturates with increasing neutron flux. An estimate of the density of lattice defects can be made from the photoconductivity. An energy-level model is proposed to explain the various photoconductivity bands and the enhancement and saturation effects. (auth)

5649

LIGHT OUTPUT OF POTASSIUM IODIDE CRYSTALS UNDER BOMBARDMENT BY HEAVY CHARGED PARTICLES. W. T. Link and D. Walker. *Proc. Phys. Soc. (London)* A66, 767-70(1953) Aug.

Some measurements of the relative light output of KI(Tl) crystals as a function of incident-particle energy for protons of up to 10 Mev, for deuterons of up to 20 Mev, and for α particles of up to 40 Mev are reported. The relation between light output and particle energy has been found to be noticeably non-linear in all cases. (auth)

RADIOACTIVITY

5650

Argonne National Lab.

THE HALF LIFE OF Am^{243} . Herbert Diamond, Paul R. Fields, Joseph Mech, Mark G. Inghram, and David C. Hess. June 1953. Decl. with deletions July 17, 1953. 4p. (AECD-3543; ANL-WMM-1109)

A sample of Am^{243} formed by pile irradiation of Pu was chemically purified, and the mass ratio of Am^{243} to Am^{241} was determined accurately with a 60° , 12-in. radius mass

spectrometer with a multiple filament ionization source. The ratio of the α activities of the Am isotopes was measured in a differential α pulse analyzer. From these data and the known Am^{241} half life (470_{-10}^{+5} yr), the α half life of Am^{243} was found to be $8.8 \pm 0.6 \times 10^3$ yr. (J.A.G.)

5651

Brookhaven National Lab.

GAMMA-GAMMA DIRECTIONAL CORRELATION EXPERIMENTS WITH $\text{Mo}^{93\text{m}}$. J. J. Kraushaar. 12p. (BNL-1525)

Three directional correlations have been measured involving the three successive γ rays emitted following the 7.0-hr state in $\text{Mo}^{93\text{m}}$. The spins and multipoles are characterized and are consistent with Goldhaber's postulation on the basis of core isomerism. (auth)

5652

Ames Lab.

RADIOISOTOPE P^{33} . R. T. Nichols and E. N. Jensen. June 4, 1953. 15p. (ISC-352)

Radioactive P was obtained by an (n,p) reaction on S which had been electromagnetically enriched in S^{33} . The β spectrum of this P showed an increase in the low energy β group approximately proportional to the isotopic enrichment. This confirms the previous identification of this activity with P^{33} . The maximum β energy was determined from several Kurie plots and found to be 0.249 ± 0.002 Mev. The half life was found to be 24.4 ± 0.2 days. The spectrum appears to have an allowed shape as is expected from theoretical considerations. (auth)

5653

Radiation Lab., Univ. of Calif., Berkeley

AN INVESTIGATION OF THE ISOTOPES OF BERKELIUM AND CALIFORNIUM (thesis). Ervin Kenneth Hulet. July 1953. 46p. (UCRL-2283)

The nuclear decay properties of a number of Bk and Cf isotopes synthesized by charged-particle bombardment of pile-produced Cm and Am isotopes have been investigated. Among the isotopes studied, several not previously known were observed. The evidence for their mass assignment is presented. The energies of α particles of Bk^{245} and the nuclides assigned as Cm^{245} and Cf^{248} have been measured. The partial α half lives of Bk^{243} and Bk^{245} , the α half lives of the nuclides assigned as Cm^{245} and Cf^{248} , and the partial half life for spontaneous fission of Cf^{248} have been evaluated. Gamma rays and K x rays arising from the orbital electron capture of Bk^{243} , Bk^{244} , and Bk^{245} and the L x rays from the decay of Bk^{245} were examined. The orbital electron capture half lives of Bk^{245} and of the nuclides presumed to be Bk^{244} and Bk^{246} were measured, and a lower limit for the occurrence of this process in Cm^{243} was estimated from experimental data. The assignment of the mass number of the isotope previously referred to as Cf^{248} has been proved. For isotopes investigated in this research, the observed α -decay data were found to substantiate the correlations of the α -decay systematics. (auth)

5654

THE ISOTOPIC INVARIANT THEORY OF β DISINTEGRATION. V. V. Sudakov. *Doklady Akad. Nauk S.S.S.R.* 90, 1009-10(1953) June 21. (In Russian)

The electron, positron, and neutrino have been investigated as a triad for isotopic spin and equal parity. Three effective fields are introduced which exhibit the components of the isotopic vectors of light particles. A formula is devised for the β interaction in isotopic invariant form. (J.S.R.)

5655

A LIQUID ARGON IONIZATION CHAMBER MEASUREMENT OF THE SHAPE OF THE BETA-RAY SPECTRUM OF K^{40} . John H. Marshall. *Phys. Rev.* 91, 905-9(1953) Aug. 15.

A liquid-argon ionization chamber has been used to compare the shape of the β -ray spectrum of K^{40} with those of Y^{91} and P^{32} . The K^{40} spectrum is found to be consistent with the shape factor $D_2 = p^6 + 7p^4q^2 + 7p^2q^4 + q^6$, in agreement with recent measurements. (auth)

5656

RADIOACTIVE EUROPIUM 150 AND GADOLINIUM 150. Rex C. Mack, J. J. Neuer, and M. L. Pool. *Phys. Rev.* **91**, 903-4(1953) Aug. 15.

The enriched isotopes of Sm were bombarded with 6.7-Mev protons. A well-defined 13.7-hr activity was measurable in all of the enrichments. Comparison of relative initial saturation intensities clearly indicated that the activity should be assigned to Eu^{150} . The activity is the result of negatron emission. The negatron spectrum has maximum energy of 1.07 Mev, and is classified as a first-forbidden transition on the basis of the log ft value. The Eu^{150} activity enables a lower limit of 10^5 years to be placed on the half life of the α decay which has been assigned to Gd^{150} . (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

5657

Ames Lab.

THE MAGNETIC SUSCEPTIBILITY OF NEODYMIUM METAL. J. F. Elliott, S. Legvold, and F. H. Spedding. [July 9, 1953] 9p. (ISC-363)

The magnetic susceptibility of Nd metal has been measured over the temperature range of 20.4 to 300°K. The metal was found to obey a Curie-Weiss law above 145°K with a paramagnetic Curie point of -16°K and an effective moment of 3.68 Bohr magnetons. Near 145°K there appears to be a change in slope of the $1/\chi$ vs. T curve. From 145 to 31.5°K the metal again obeys a Curie-Weiss law with a paramagnetic Curie point of about 1°K and an effective moment of 3.35 Bohr magnetons. The susceptibility at 20.4°K is much larger than predicted by the low-temperature Curie-Weiss law and has a definite field dependence. (auth)

THEORETICAL PHYSICS

5658

Stanford Univ.

LATTICE-SPACE QUANTIZATION OF A NONLINEAR FIELD THEORY. L. I. Schiff. Aug. 6, 1953. 39p. (AECU-2635; Technical Report 2)

A method for the approximate diagonalization of certain types of quantum-field Hamiltonians is developed which is not limited to weakly nonlinear systems. It consists of omitting the gradient terms in zero order and diagonalizing the resulting Hamiltonian by replacing the field defined in a continuum space by a field defined in a lattice space. This unperturbed system is equivalent to a countably infinite number of uncoupled nonlinear oscillators, which are then coupled together when the gradient terms are included as a perturbation. The method is applied to the quantization of the classical nonlinear meson theory that was introduced in an earlier paper to provide a qualitative explanation of the saturation of nuclear forces, according to which a positive term is added to the field Hamiltonian. Although the quantized theory is manifestly noncovariant, it is found that a single-particle solution exists that has an approximately relativistic relation between energy, momentum, and rest mass. It turns out to be essential that the lattice constant be kept finite, as all computed physical quantities become meaningless in the continuum limit (in which the lattice constant approaches zero). It is shown that these particles obey Einstein-Bose statistics and that they scatter from each other. Nucleons are introduced as classical sources for the meson field, and calculations

are made on the nucleon isobaric state, interaction of mesons with nucleons and heavy nuclei, and nucleon-nucleon interaction. Most of the results of the earlier classical theory have close counterparts in the present quantized theory. The possibility of extending the method to the quantization of both meson and nucleon fields when they are strongly coupled together is discussed briefly. (auth)

5659

Brookhaven National Lab.

INNER BREMSSTRAHLUNG AND THE MAGNETIC MOMENT OF THE NEUTRINO. J. Weneser. (1953) 5p. (BNL-1514)

A relativistic treatment is given to a method previously proposed (*Phys. Rev.* **90**, 721(1953) May 15) for the detection of a neutrino magnetic moment by its contribution to inner bremsstrahlung. The results of this approach provide an expression which is finite in the limit of 0 rest mass. It is concluded that inner bremsstrahlung provides a less sensitive test for an upper limit to the neutrino magnetic moment than previous results obtained by ionization analysis. (K.S.)

5660

CONTRIBUTION TO THE STUDY OF THE METHODS OF THE SECOND QUANTIZATION AND OF THE SPACE CONFIGURATION IN THE RELATIVITY THEORY OF SYSTEMS OF PARTICLES; APPLICATION TO THE DERIVATION OF RELATIVISTIC EQUATIONS FOR THE DEUTERON.

Maurice Jean. *Ann. phys.* **8**, 338-91(1953) May-June. (In French)

The theories of V. Fock, R. Becher, and C. Leibfried are generalized in the limits of the relativistic theory of quantized fields. It is shown, by two examples, that it is possible, in a covariant manner, to derive a Fock representation which will allow a direct transition from the second quantization to the space configuration. The equivalence of the two formalisms for isolated fields is proved. The covariant method can be used for interacting fields if the interaction constants are introduced. A Fock representation, derived for the field of interacting fermions and bosons, was used to derive a relativistic equation describing a system of two fermions. (J.S.R.)

5661

THE THEORY OF STRONG TIES FOR MESON FIELDS.

B. T. Geilikman. *Doklady Akad. Nauk S.S.S.R.* **90**, 991-4 (1953) June 21. (In Russian)

The interactions of a pseudoscalar field with quiescent particles of finite mass are investigated. A nonrelativistic approximation of the energy of the interacting particles is given. A theory of bonds in the meson field is then derived. (J.S.R.)

5662

THE CLASSICAL EQUATIONS OF MOTION OF POINT PARTICLES. II. Peter Havas. *Phys. Rev.* **91**, 997-1007(1953) Aug. 15.

In Part I of this paper (see NSA 6-6404) the problem of the relation of field theory and the theory of action at a distance was investigated for the neutral vector and scalar meson theories. The work is here extended to the charge-symmetrical meson theory. First the equations of motion of particles interacting through vector meson fields are found for half-retarded, half-advanced interaction, using the field-theoretical methods developed for retarded interaction; equations for both cases are given for particles interacting through scalar meson fields. These equations contain integrals over the past and entire motion in the retarded and symmetric case, respectively. These are inadmissible from the point of view of action at a distance, and new equations are postulated. Variational principles are developed for these equations, and energy-momentum tensors and charge-current vectors guaranteeing detailed conservation laws are defined. The application of the

Wheeler-Feynman method to the equations of both theories is discussed. Conclusions analogous to those found in the neutral case are obtained. (auth)

5663

ON THE STRUCTURE OF THE INTERACTION OF THE ELEMENTARY PARTICLES. IV. ON THE INTERACTION OF THE SECOND KIND. Susumu Kamefuchi and Hiroomi Umezawa. Progr. Theoret. Phys. (Japan) **9**, 529-49(1953) May.

By extending the method of the renormalization theory and making use of the similar idea of radiation damping, a possibility is examined of establishing the non-singular theory of interactions of the second kind. When using the propagation functions modified by the field reaction in place of the usual one, less singular theories can be obtained. It is shown that for a given set of interactions, some of which belong to the second kind, the non-singular theory can always be constructed, if, when necessary, auxiliary interactions of the second kind are introduced. Several examples of the non-singular theory obtained in this way are given, and some remarks are further added in connection with the characteristic features of this method. (auth)

5664

THE GENERAL THEORY OF THE INTERACTION REPRESENTATION. II. GENERAL FIELDS AND INTERACTIONS. Hiroomi Umezawa and Yasushi Takahashi. Progr. Theoret. Phys. (Japan) **9**, 501-23(1953) May.

In the case when the interaction contains higher derivatives than the free part the method of the previous paper (Progr. Theoret. Phys. (Japan) **9**, 14(1953)) is extended. It is shown that the formalism is perfectly equivalent to Heisenberg-Pauli's method, but not to Ostrogradski's. Lastly, an example of the quantization of non-local interaction is given. (auth)

5665

ON THE INTERPRETATION AND GENERALIZATION OF DIRAC'S THEORY OF THE ELECTRON. Walter Wessel and S. J. Czyzak. Phys. Rev. **91**, 986-94(1953) Aug. 15.

The independence of momentum and velocity in Dirac's theory of the electron may be understood classically as a consequence of the radiation reaction force. In earlier work one of the authors tried to interpret the whole spin phenomenon on this basis, considering the new degrees of freedom as representatives of the higher time derivatives in the equation of motion of a particle extended in space. A consequent treatment of this question by Bopp on the basis of his linear electrodynamics revealed that this program is possible only for integral spin; also, it seemed to be necessary to ignore the non-conservative part of the radiation reaction force. It is shown here that without alteration of the new formalism the spin may be introduced as an intrinsic feature of the particles, as in older theories, so that half-integral values are included. The Poisson brackets are derived in full generality without reference to a specific model by extension of an idea of Anderson. It is then shown by a contact transformation first discovered in quantum mechanics that the motion under the (third order) radiation reaction force is contained as a particular integral in the (fourth order) equations of motion, which we have in common with Bopp. This holds exactly in absence of the Lorentz force and suggests a simple scheme for the interpretation in quantum mechanics of the radiation reaction. In order to maintain nearly the particular motion in presence of the Lorentz force, a slight alteration of the Hamiltonian is necessary, which has empirical support from the evaluation of the corresponding wave equation. (auth)

5666

DIPOLAR BROADENING OF THE QUADRUPOLE RESONANCE LINE WIDTH IN ZERO APPLIED FIELD. A.

Abragam and K. Kambe. Phys. Rev. **91**, 894-7(1953) Aug. 15.

A formula has been derived for the contribution of the dipolar broadening to the second moment of the resonance line in pure quadrupole resonance experiments. The following assumptions have been made: The nuclear spins undergoing the resonant transitions have spin 1 or $\frac{3}{2}$. No restriction has been set on the spins of "nonresonant" nuclei contributing to the dipolar broadening. The electric-field gradients at all nuclear sites have axial symmetry and common directions. A comparison is made with Van Vleck's formula for straight magnetic resonance. (auth)

5667

POLES OF THE S MATRIX FOR RESONANCE REACTIONS. Marcos Moshinsky. Phys. Rev. **91**, 984-5(1953) Aug. 15.

Restrictions are obtained on the position of the poles of the S matrix for resonance reactions, that are a consequence of the definition of the S in terms of Wigner's R matrix. (auth)

5668

THE BORN-YANG NUCLEAR MODEL FOR HIGH ENERGY ELECTRON SCATTERING. A. L. Mathur and K. M. Gatha. Proc. Phys. Soc. (London) **A66**, 773-4(1953) Aug.

The Born-Yang model, a model characterized by the radius $R = fA^{1/3}$ cm and non-uniform density distribution, is used to study the nuclear scattering of 15.7-Mev electrons. (L.M.T.)

5669

THEORY OF MULTIPOLE RADIATION. J. B. French and Y. Shimamoto. Phys. Rev. **91**, 898-9(1953) Aug. 15.

The connection between the exact multipole moments and their long wavelength approximations is examined. Special attention is paid to the role which the condition that the radiation source be bounded plays in this connection. The multipole expansion is made in a very simple manner. (auth)

5670

A ROTATIONAL SYMMETRICAL SOLUTION IN THE GENERAL RELATIVITY THEORY. A. Papapetrou. Ann. Physik **12**, No. 4-6, 227-36(1953). (In German)

A new exact rotational symmetrical solution of the field equations of the general relativity theory has been derived. The physical significance of the solution has been investigated. (J.S.R.)

5671

REMARKS ON LÉVY'S FOURTH ORDER POTENTIAL. Tetsuo Hamada and Masao Sugawara. Progr. Theoret. Phys. (Japan) **9**, 555-7(1953) May.

Lévy (Phys. Rev. **88**, 725(1952)) calculated the fourth-order nucleon-nucleon interaction via the symmetrical pseudoscalar meson field, using the extended form of the Tamm-Dancoff method for the nonadiabatic treatment of two-body problems. He found that the contributions from the processes which involve just one virtual pair, which are also of the order $(G^2/4\pi)^2 (\mu/2M)^3$, cancel each other. The authors found this to be incorrect, and this note aims at clarification of this point. (L.M.T.)

5672

A NON-LOCAL WAVE EQUATION AND ITS CONNECTION WITH THE DIRAC PARTICLE. Takehiko Takabayasi. Progr. Theoret. Phys. (Japan) **9**, 557-9(1953) May.

A case where the wave equation of a single particle is essentially non-local is examined. The wave equation can be regarded as the transformed wave equation of a free Dirac particle by suitable arrangement of ψ into a spinor. To be explicit, the Dirac wave equation is transformed by canonical transformation, and the transformed equation is separated into four independent equations for each spinor component. (L.M.T.)

5673

THE THEORY OF THE STRUCTURE OF ELEMENTARY PARTICLES. Osamu Hara and Toshio Marumori. Progr. Theoret. Phys. (Japan) 9, 559-60(1953) May.

In a previous paper (Hara and Shimazu, Progr. Theoret. Phys. (Japan) 8, 385(1952)) it was suggested to regard the elementary particles as corresponding to various states of the internal motion of a kind of "Urmaterie," and it was pointed out that the non-local field would be nothing but the one that would describe the Urmaterie. Some development of this idea is discussed in this note. (auth)

5674

THE THEORY OF THE INTERACTIONS WITH HIGHER DERIVATIVES. Yasuhisa Katayama. Progr. Theoret. Phys. (Japan) 9, 560-2(1953) May.

The theory of non-local interaction is developed, with the assumption that the non-local interactions are the infinite sums of the interactions with higher derivatives. (L.M.T.)

5675

MATRIX ELEMENTS IN RADIATIVE TRANSITIONS. R. J. Blin-Stoyle. Proc. Phys. Soc. (London) A66, 729-32(1953) Aug.

The matrix elements occurring in the theory of radiative transitions of electrons and positrons for a case of spherical symmetry are expanded in the general case as a series of radial integrals with known coefficients. (auth)

